POWER FACTOR REGULATOR

COMPUTER plus T8/14 (Three-phase Metering - Relays Output)

INSTRUCTION MANUAL

M98223001-03-13A

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INTRODUCTION

CIRCUTOR S.A. would like to thank you for showing your trust by choosing one of our **Computer plus** series regulators.

These units are constructed with state-of-the-art technology, including a powerful DSP to calculate the optimum algorithms for achieving the best compensation of cos φ.

The units comply with the Electrical Safety Standard EN 61010, in accordance with the requirements of the Low Voltage Directive (LVD) 73/23/EC besides of EMC Directive (20004/108/CE) and, therefore, they are certified to carry the CE mark.

This user manual describes the operation of the **Computer plus** series regulators and shows the user the procedures required to install, commission and operate the units.

SAFETY

CAUTION!	The installation and maintenance of the unit must be performed by duly trained and authorized staff, in accordance with the national and international standards.

DANGER!	Before performing any maintenance operation on the cos φ regulation units, be sure to disconnect the main switch. After disconnecting it, wait at least 5 minutes to ensure that the capacitors have totally discharged.

During the installation, maintenance or commissioning of the units regulated by a **Computer plus** unit, the following safety precautions must be observed:

- ✓ Before connecting the units make sure the earth terminals have been connected correctly. A defective earthing connection may cause the unit to work incorrectly and represent a danger of electric shock to the user the person operating it.

- ✓ Maintenance must be performed taking the necessary precautions to avoid electrocution and electric shock. Before any intervention, we recommend you ensure the unit has been disconnected and wait during the time necessary for the capacitors to discharge fully. We recommend the use of safety goggles and gloves when necessary.
- ✓ If the PF compensation units are connected without load, resonance may occur, so that the voltage harmonics may be amplified and may damage the compensation unit and other equipment connected to the network.
- ✓ The start-up and interruption procedures indicated in the manual must be followed to avoid damaging the unit and/or adjacent units.
- ✓ The adjustment or replacement of components or parts of the unit must be made with original replacement parts and in accordance with the procedures described in the corresponding instruction manual.

1 COMPUTER PLUS T POWER FACTOR REGULATORS

The regulators in the **Computer plus** series are power factor regulators that incorporate the latest advances in technology regarding reactive energy compensation and harmonic filtering, both in systems with contacts and in fast systems. The core of the controller is a state-of-the-art DSP processor that allows the quick and efficient execution of advanced control algorithms.

The **Computer plus T** regulators described in this manual are relay output regulators to be used with contactors driven capacitor banks. For more information about the fast model, see manual M98223301-03-AAx. (AAx: AA are the two last figures of the revision year and x is an alphabetic character, A…Z, which indicates the version).

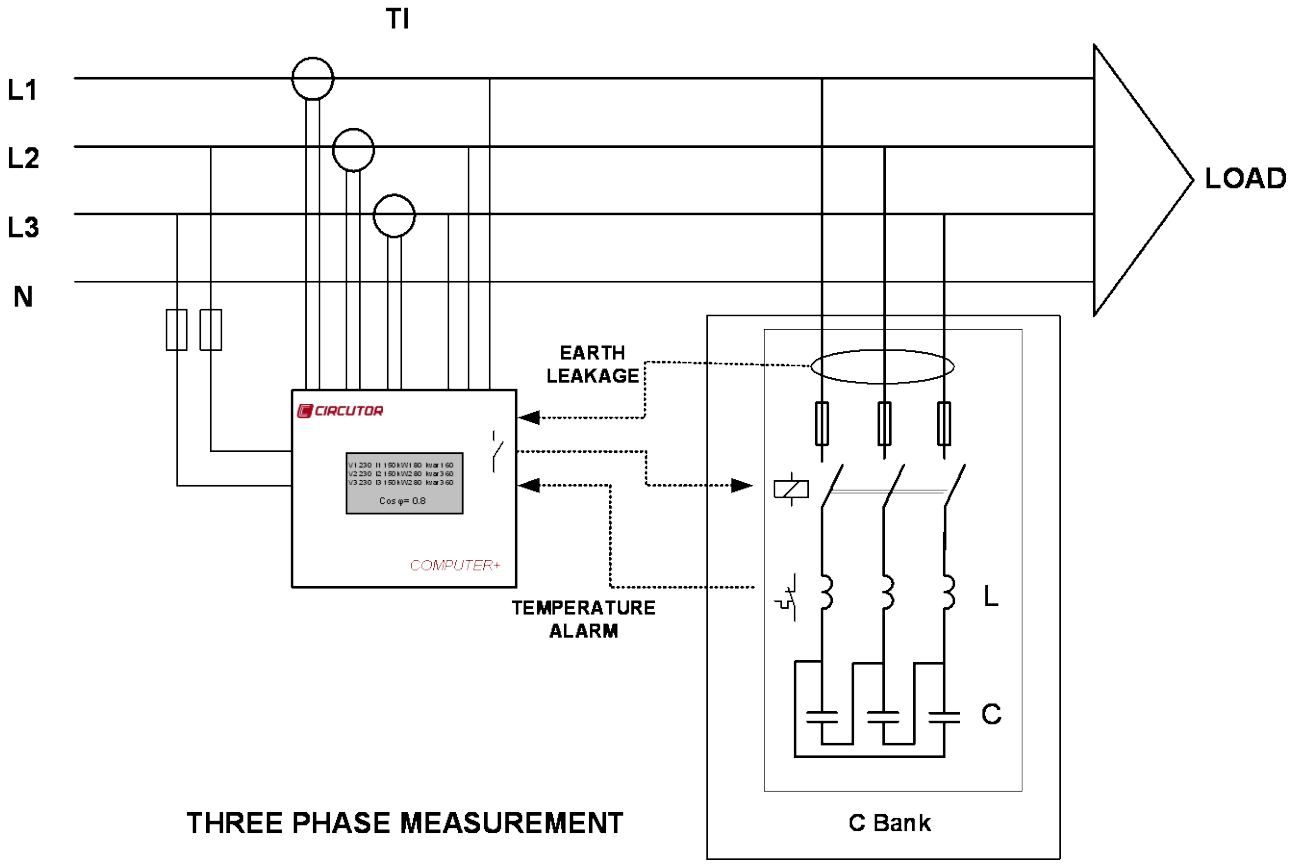


Fig. 1 .- Schematic diagram of connections

Types and basic functions:

TYPE	VOLTAGE (V a.c.)	OUTPUT	METERING	OTHER FUNCTIONS
Computer plus T8	110-480	8 Relays	Three-phase	Basic type
Computer plusT8-CDI	110-480	8 Relays	Three-phase	Basic type + Communications + Leakage metering + Capacitor metering
Computer plus T14	110-480	14 Relays	Three-phase	Basic type
Computer plus T14-CDI	110-480	14 Relays	Three-phase	Basic type + Communications + Leakage metering + Capacitor metering

2 TECHNICAL SPECIFICATIONS

Power supply circuit:	110 at 480 V a.c. (50…60 Hz) (± 10%) Burden: • Without relays: 6.6 VA / 230 V ÷ 19 VA / 400 V ÷ 24.9 VA / 480 V • With 8 relays connected: 10.2 VA / 230 V ÷ 26.6 VA / 400 V ÷ 34.6 VA / 480 V • With 14 relays connected: 12.9 VA / 230 V ÷ 33 VA / 400 V ÷ 43 VA / 480 V
Voltage circuit: Measuring range Maximum burden Frequency	 From 5% to 120 % for Un = 300 V a.c. (phase-neutral) From 5% to 120 % for Un = 520 V a.c. (phase-phase) < 0.6 VA 45 ... 65 Hz
Current circuit: Rated current Admissible overload Burden (…/5 A and …/ 1 A)	 Transformers In / 5 A a.c. or In / 1 A a.c. 6 A permanent, 100 A t < 1 s < 0.45 VA
Integrated control system	FCP or Linear / 4 quadrants
Integrated control algorithm	Three-phase
Output relays: Maximum voltage Ui Thermal current Ith AC11 Ie / Ue DC11 Ie / Ue Mechanical endurance Electrical endurance	 277 V a.c. / 30 V d.c. 6 A 6 A / 250 V a.c. 6 A / 30 V d.c. $1 \cdot 10^7$ operations $3 \cdot 10^4$ operations
Environment: Working temperature Storage temperature Maximum relative humidity Maximum working altitude Installation category Pollution grade Protection degree	 -10º at +50 ºC -20º at +65 ºC 95 % without condensation 2000 m (AMSL) Installation category III, as per IEC 61010 2, as per IEC 61010 IP 51 frontal side - IP 20 rear part

Safety:	
Installation category	Installation category III, as per IEC 61010
Protection against electric shock	Double isolation Class II Designed and identified with CE mark
Mechanical characteristics:	
Connection	Direct connection terminals for rigid wire of 2.5 mm (4.5 mm^2) or flexible (AWG 11)
Case material	Self-extinguishing V0 plastic
Dimensions	According to fig. 2
Weight	0.607 kg (8 relays) / 0.640 kg (14 relays)
Standards:	
EMC	IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-11

2.1 Dimensions and fixings

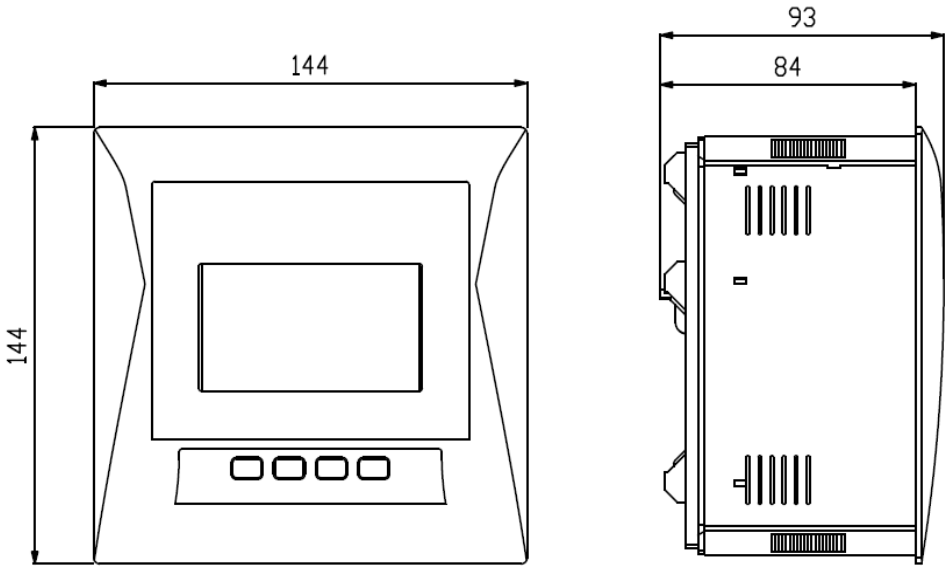
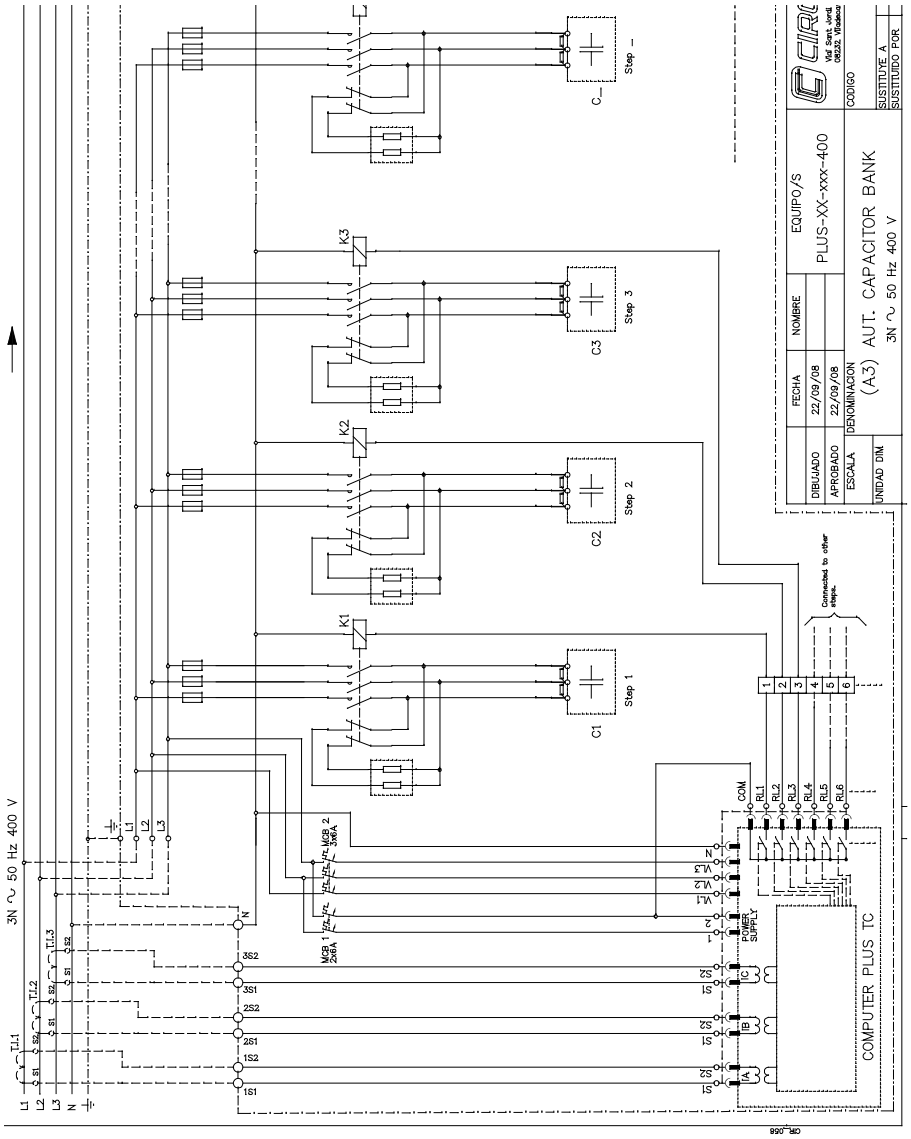


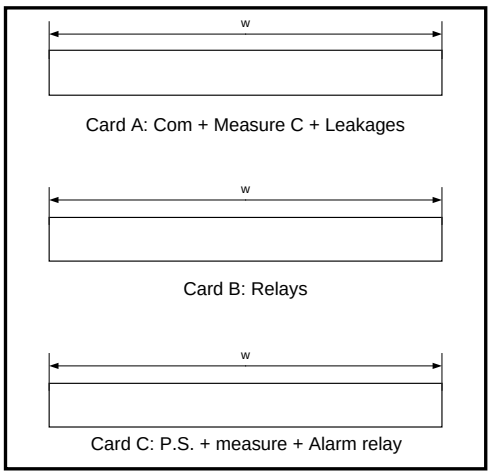
Fig. 2 .- External dimensions

The unit is intended to be installed in the panel door (drill panel 138^{+1} x 138^{+1} mm according to DIN 43 700).

3 STANDARD CONNECTION DIAGRAM



3.1 Cards and functions



The **Computer plus** unit can use different cards, depending on the functions available.

Card A: Communications. Capacitors Current Measurement and Leakage Measurement

Card B: Relays

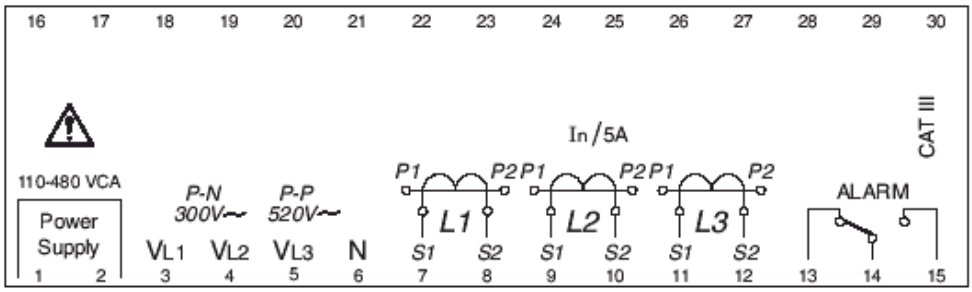
Card C: Power supply and measurement

The **Computer plus T8** and **T14** types only use B and C cards

The **Computer plus T8-CDI** and **T14-CDI** types use A, B and C cards

3.2 Allocation of terminals

3.2.1 Card C: Power supply and metering



CARD C TERMINALS	FUNCTION
1	Power supply
2	Power supply
3	Voltage 1
4	Voltage 2

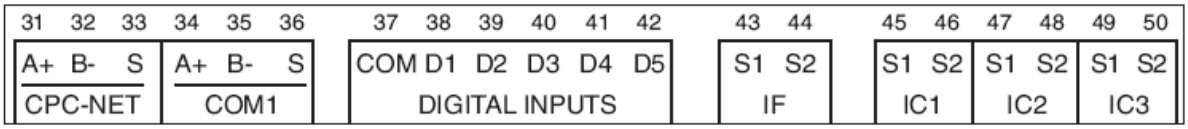
5	Voltage 3
6	Neutral
7	Secondary 1 Current IA
8	Secondary 2 Current IA
9	Secondary 1 Current IB
10	Secondary 2 Current IB
11	Secondary 1 Current IC
12	Secondary 2 Current IC
13	Alarm Relay NC Contact
14	Alarm Relay Common
15	Alarm Relay NO Contact

3.2.2 Card B: Relays

CARD B TERMINALS	ALLOCATION	FUNCTION
16	COM	Common Relays
17	RL1	Relay 1
18	RL2	Relay 2
19	RL3	Relay 3
20	RL4	Relay 4
21	RL5	Relay 5
22	RL6	Relay 6
23	RL7	Relay 7
24	RL8	Relay 8
25	RL9	Relay 9 (*)
26	RL10	Relay 10 (*)
27	RL11	Relay 11 (*)
28	RL12	Relay 12 (*)
29	RL13	Relay 13 (*)
30	RL14	Relay 14 (*)

(*) Only available for the **Computer plus T14 and T14-CDI** types

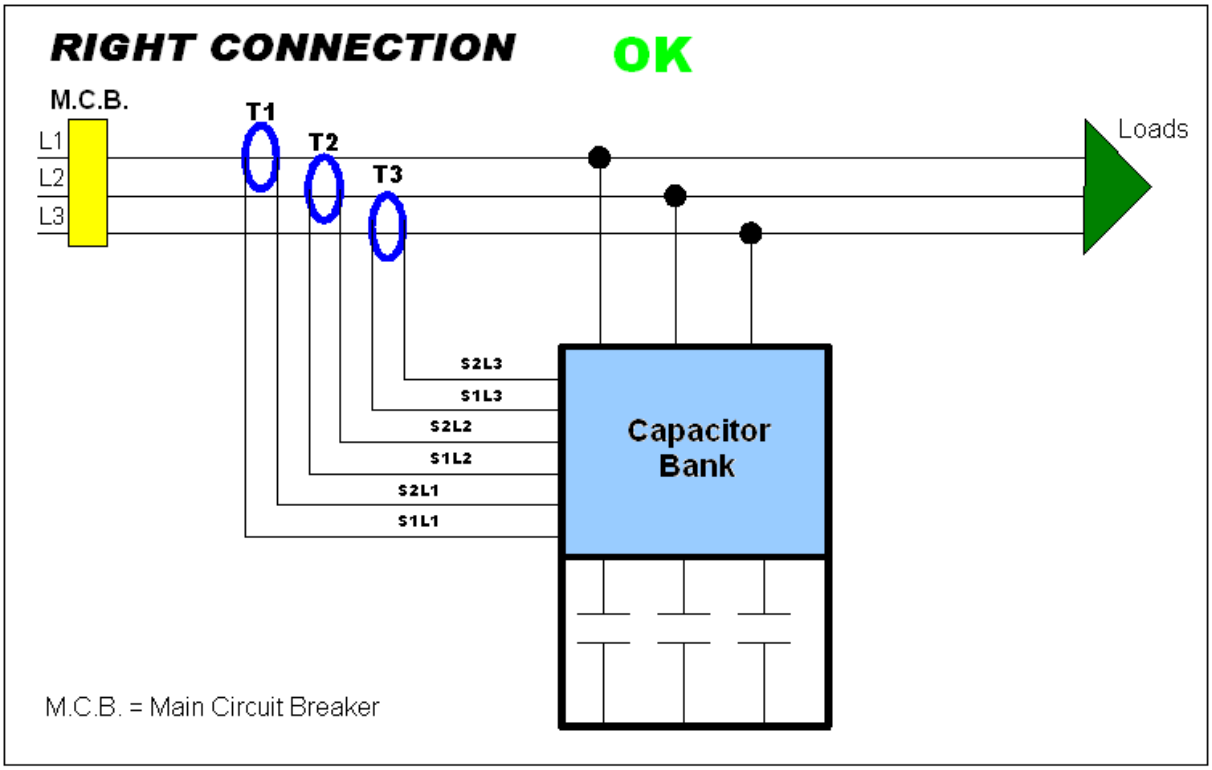
3.2.3 Card A: Communications, measurement I in capacitors and measurement I in leakages

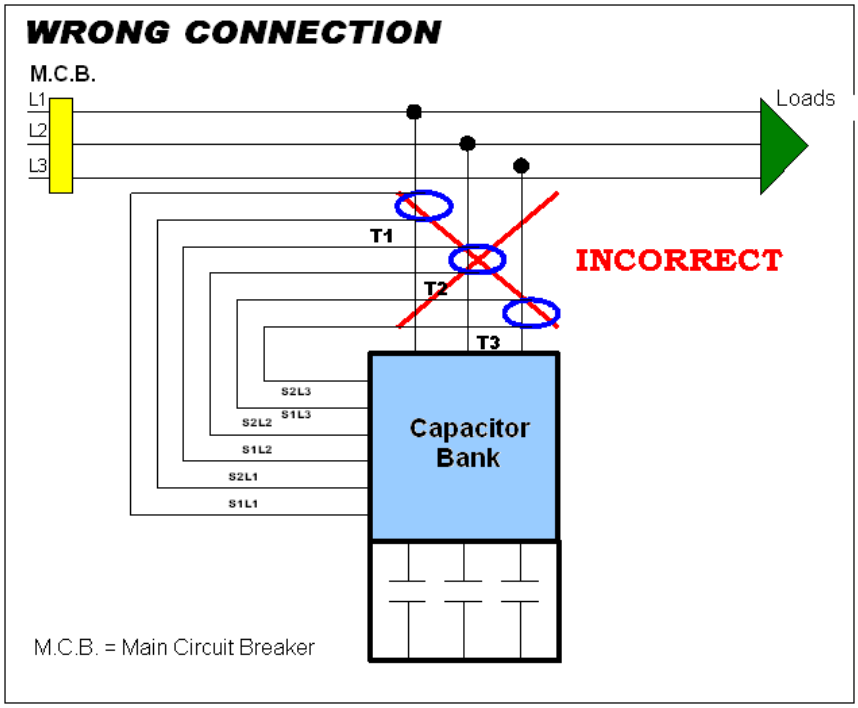


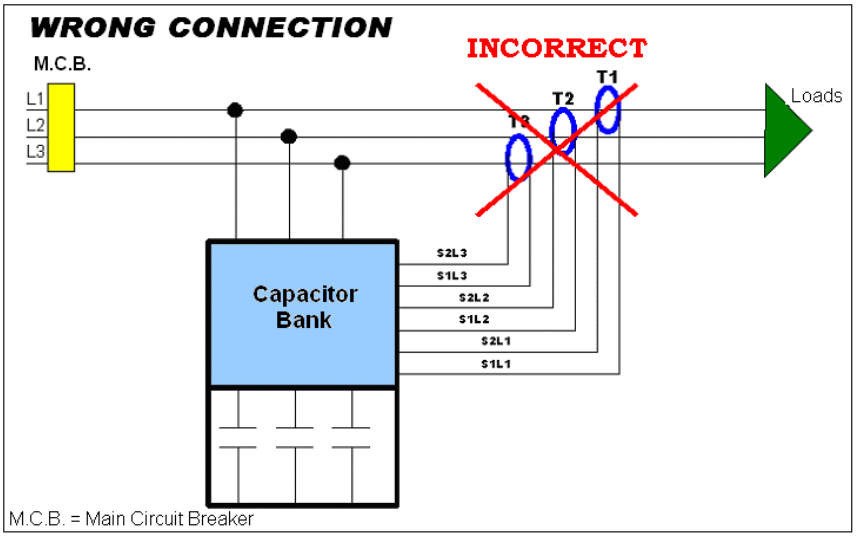
CARD A TERMINALS	ALLOCATION	FUNCTION
31	A+	Terminal A+ RS-485 (control of capacitors Only TF versions)
32	B-	Terminal B- RS-485 (control of capacitors Only TF versions)
33	S	Terminal S- RS-485 (control of capacitors Only TF versions)
34	A+	Terminal A+ Communications RS-485
35	B-	Terminal B+ Communications RS-485
36	S	Terminal S Communications RS-485
37	COM	Common Digital Inputs
38	D1	Digital Input 1
39	D2	Digital Input 2
40	D3	Digital Input 3
41	D4	Digital Input 4
42	D5	Digital Input 5
43	IF - S1	Earth leakage transformer, I leakages Secondary 1
44	IF - S2	Earth leakage transformer, I leakages Secondary 2
45	IC1 - S1	Metering transformer, I capacitors, phase 1. Secondary 1
46	IC1 - S2	Metering transformer, I capacitors, phase 1. Secondary 2
47	IC2 - S1	Metering transformer, I capacitors, phase 2. Secondary 1
48	IC2 - S2	Metering transformer, I capacitors, phase 2. Secondary 2
49	IC3 - S1	Metering transformer, I capacitors, phase 3. Secondary 1
50	IC3 - S2	Metering transformer, I capacitors, phase 3. Secondary 2

3.3 Basic connection diagram

- The PF equipment requires current transformers which must be installed at the mains supply line, so that the total current of the installation can flow through them (load current + current of the capacitors).




WRONG CONNECTION
M.C.B.
L1
L2
L3
Loads
T1
T2
T3
INCORRECT
S2L3
S1L3
S2L2
S1L2
S2L1
S1L1
Capacitor Bank
M.C.B. = Main Circuit Breaker


WRONG CONNECTION
M.C.B.
INCORRECT
L1
L2
L3
T1
T2
T3
Loads
S2L3
S1L3
S2L2
S1L2
S2L1
S1L1
Capacitor Bank
M.C.B. = Main Circuit Breaker

4 SETTINGS AND START-UP

Read the safety instructions in the introduction of this manual. You must respect these conditions to guarantee the safe operation of the unit and keep it in good condition regarding safety. The unit must not be used and programmed until it has been installed in its position in the electrical panel with the adequate protection elements.

If you use the unit in a way that is not specified by the manufacturer, the protection of the unit may be compromised.

If the unit has been damaged, burnt or hit by any element, the internal circuits might have been damaged and the safety protection elements might not been in full working order. In this case, disconnect the power supply and contact the authorized Technical Service to request a replacement.

4.1 Checks before the unit is powered

Before powering the unit, check the following points:

a.- Auxiliary power supply:

- Voltage: 110 - 480 V a.c. (± 10%)
- Frequency: 50 ... 60 Hz

b.- Rated voltage in voltage measuring circuit:

- Maximum rated voltage: U_{p-N}: 300 V a.c. / U_{p-p}: 520 V a.c.
- Frequency: 45 ... 65 Hz

c.- Rated current in current measuring circuit:

- Secondary … / 5 A: 5 A a.c.
- Secondary … / 1 A: 1 A a.c.

d.- Working conditions:

- Operation temperature: -10º a +50 ºC
- Relative humidity: < 95 % without condensation

e.- Safety:

- Designed for installations CAT III 300 / 520 V a.c. as per EN 61010.
- Protection against electric shock by means of Class II double insulation.

The unit is intended to be installed in the panel door (according to DIN 43 700):

- Drill panel 138^{+1} x 138^{+1} mm

	All connections keep inside the cabinet. Note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. Therefore, the instrument must not be used until this is completely installed.

	The regulator should be connected to a power supply circuit protected by gl type (IEC 269) or M type fuses (IEC 127), rated between 0.5 and 2 A. It should be provided with a MCB or equivalent device to switch off the system from the power supply circuit. Both power supply and voltage measuring circuits as well as connections to different relays will be wired with cables of a minimum cross-section of 1 mm^2 (AWG 17). The current transformer secondary side connection line should have a minimum cross section of 2 mm2 (AWG 14) and with a minimum temperature rating of 60 ºC.

To connect a **Computer plus** regulator to a PF compensation unit, follow these steps:

- Connect the power supply terminals (1 and 2 in Card C) to the control panel's voltage source.
- Connect terminals VL1, VL2, VL3 and the neutral N (if available) to the network's phases and neutral.
- **VERY IMPORTANT!!!:**

The device considers that phase 1 is the phase connected to the VL1, phase 2 will be that connected to VL2 and phase 3 that connected to the regulator's VL3. (Cables L1, L2 and L3 of the power supply connection).

- Connect current transformers T1, T2 and T3 to phases 1, 2 and 3, respectively. If you do not connect each transformer to the corresponding phase, the “Plug and Play” setting can be used to detect them automatically. In addition, they can be configured manually with the *Connection of Transformers V-I* option in the *Setup* menu folder.
- Make sure that the cables (S1-S2) coming from the secondary connections of the current transformers are connected to terminals S1-S2 of the **Computer plus** unit. If you do not connect each transformer to the corresponding phase, the “Plug and Play” setting can be used to detect them automatically. In addition, they can be configured manually with the *Connection of Transformers V-I* option in the *Setup* menu folder.

4.2 Energizing the regulator

- The device can be energized once the power supply and measuring cables have been connected.
- After energizing the **Computer plus** unit and waiting for a start-up time of 10 seconds, the device will start to display the values measured. Some information might not be coherent (cos φ out of reasonable margins, active power values with a negative sign, etc.). This is usually the result of incorrect connections (current transformers connected to the incorrect phase or inverting S1-S2).

  Any of these errors can be solved without changing the cables; simply enter the setup menu of the device, select option *Connection of Transformers V-I* (see section 7.3), or execute the "Plug and Play" option (see section 7.2).

  NOTE: If you connect the unit and it does not operate, remember that it must be put in the RUN mode (section 7.3.9)

4.3 Regulator settings

ATTENTION:

Generally, the regulator is delivered with the relay outputs disabled. Therefore, when you connect the voltage and before adjusting the setup, do not connect any capacitor step. If any capacitor is connected, this means the regulator has already been set-up.

When the regulator is installed on a CIRCUTOR capacitor bank, it has already been set-up and its final location will only need you to select the "Plug & Play" option (see section 7.2).

If you are sure that the regulator has not been set-up and a capacitor connects, this indicates that something is working incorrectly. In this case, check the settings in accordance with the instructions in section 7.

Follow these steps to adjust the unit:

- Apply voltage to the unit and follow the set-up instructions in section 7.
- Configure the alarms according to your needs by following the instructions in section 8.
- If you have a communications network and you wish to integrate the PF compensation unit into the SCADA Power Studio, follow the instructions in section 11.

5 BASIC INSTRUCTIONS TO BROWSE THE MENUS

5.1 Browsing the menus: Functions of the keys

The **Computer plus** system has four **dynamic** keys, marked as F1 F2 F3 and F4. **Dynamic** means that the functions of these keys is not always the same, because it changes on each screen. The function of each key is shown on the lower line of the corresponding screen. For example, on the screens on Figs. 5 and 6, the functions of the keys correspond to the indications on the boxes on the lower part of the screen.

In general, you can return to the main menu from any screen, by pressing the F1 key until the screen shown on Fig. 6 is displayed.

5.2 Main menu and default menu

Normally, when you power the device it performs an initial test and during this time it shows the start screen (Fig. 3). After 5 seconds, it will show an information screen (Fig. 4) with the model, software version, language, date and hour and serial number.

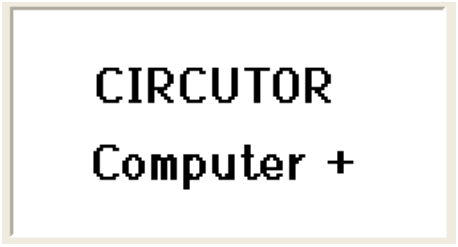


Fig. 3.- Start screen

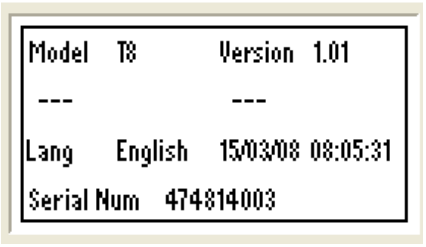


Fig. 4.- Information screen

After 5 seconds showing the information screen, the unit will display the **default screen** (Fig.5). When the unit is in the **STOP MODE** it will display a message on the top part of the screen (relay indication screen of Fig.5). In this case, the setup must be checked (see section 7).

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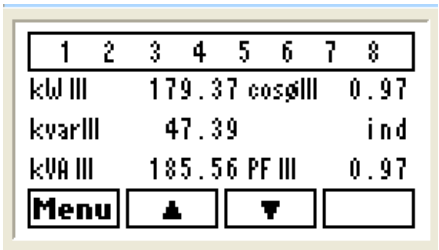


Fig. 5.- Default screen

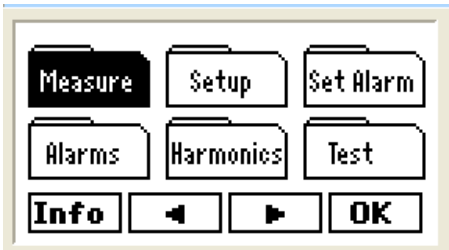


Fig. 6.- Main menu

All screens will display the menu browsing options on the lower part of the screen, which must be selected by pressing the **F1** **F2** **F3** or **F4** keys, depending on the option selected. Therefore, to move from the default screen (Fig. 5) to the main menu (Fig. 6), press **F1**.

Computer plus will jump directly to the default screen when no key has been pressed during a period of two minutes.

5.3 Basic options of the Main Menu

After powering the **Computer plus** and completing the start-up process, simply press the **F1** key various times to access the main menu (Fig.6).

6 folders will be displayed on the main menu, which correspond to the **basic functions** that can be executed by **Computer Plus**. Said functions are:

- **Measure**: Displays the parameters measured (Voltages and currents) and other parameters calculated (Power, power factor, etc.)
- **Setup**: Used to adjust the unit and adapt it to the application conditions.
- **Set Alarm**: (Alarm Setup). Used to adjust the maximum and minimum trip, delay, etc. values.
- **Alarms**: Shows the state of alarms
- **Harmonics:** Shows the voltage and current harmonics.
- **Test:** Manual connection and disconnection of steps and test of the system.

On the bottom of the main menu there are a series of menu options that can be selected with the **F1** **F2** **F3** and **F4** keys. The different menu options are:

Info Access a screen that indicates the name of the unit, and the model, version and serial number.

◄ ► Used to browse through the main menu and select the desired option.

OK To select an option and to access the desired menu.

5.4 Editing numerical or literal fields

- Many menus show the option to edit numerical or literal fields. Editing is usually done as follows:
- Press the **Edit** key and the following menu will be displayed: Esc ▲▼ Edit OK
- ▲▼ Select the field you wish to edit and press OK
- The menu will be displayed Esc ▲ ▶ OK
- When editing numbers, press the ▶ key to change the number being edited, which will appear underlined and with ▲ you can change the numerical value in cycles (0 to 9). When you reach the value desired, move onto the following character and press OK when you are finished.
- If the value edited is incorrect or out of the limits, then when you press OK, the previous value will be kept.
- When you wish to edit fields with different options, menu Esc ▲ [ ] OK will be displayed, and you can change the option with the ▲ key. When you reach the desired value, press OK

6 SUBMENU LAYOUT

Each of the **basic functions** described in the main menu (folders) has a series of options or submenus that allow you to configure the device or check the status of the different values controlled by the **Computer Plus**. The layout of the different submenu options is shown next. A detailed description can be found in section 7.

6.1 Measure menu

The measure menu allows the display of all the parameters measured or calculated by the device. The layout is shown on Fig.7

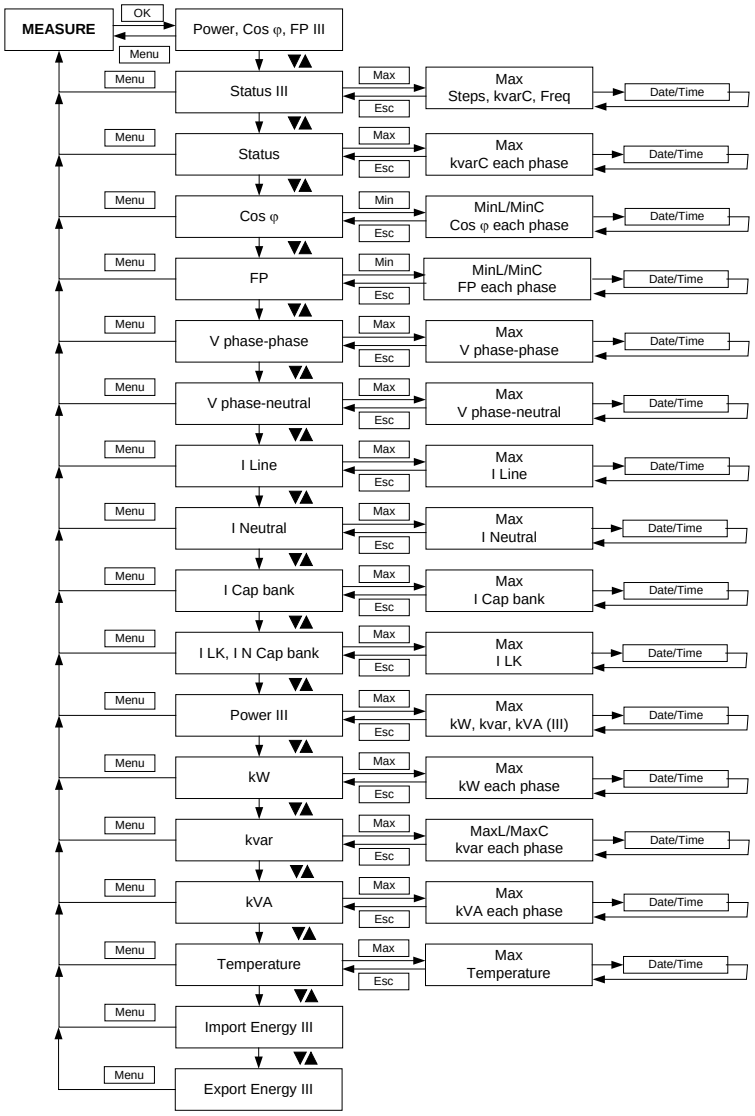
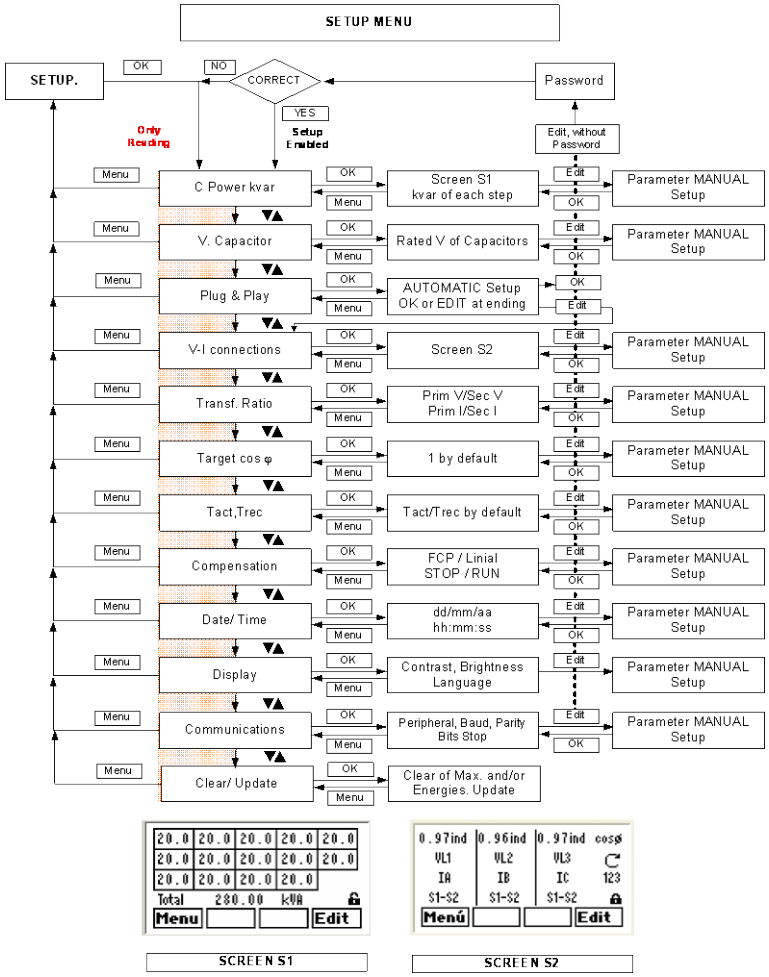


Fig.7.- Measure menu tree

6.2 Device setup menu

In the setup menu you can configure the different options of **Computer Plus**. This menu is protected by a password. You can browse the menus and see how the parameters are configured but you must choose the **Edit** option to edit them on any screen. A password will be asked before a modification is permitted. The standard password is the sequence of **F1** **F3** **F2** **F4** keys. The menu layout is shown on Fig.8 (for more details, see section 7).

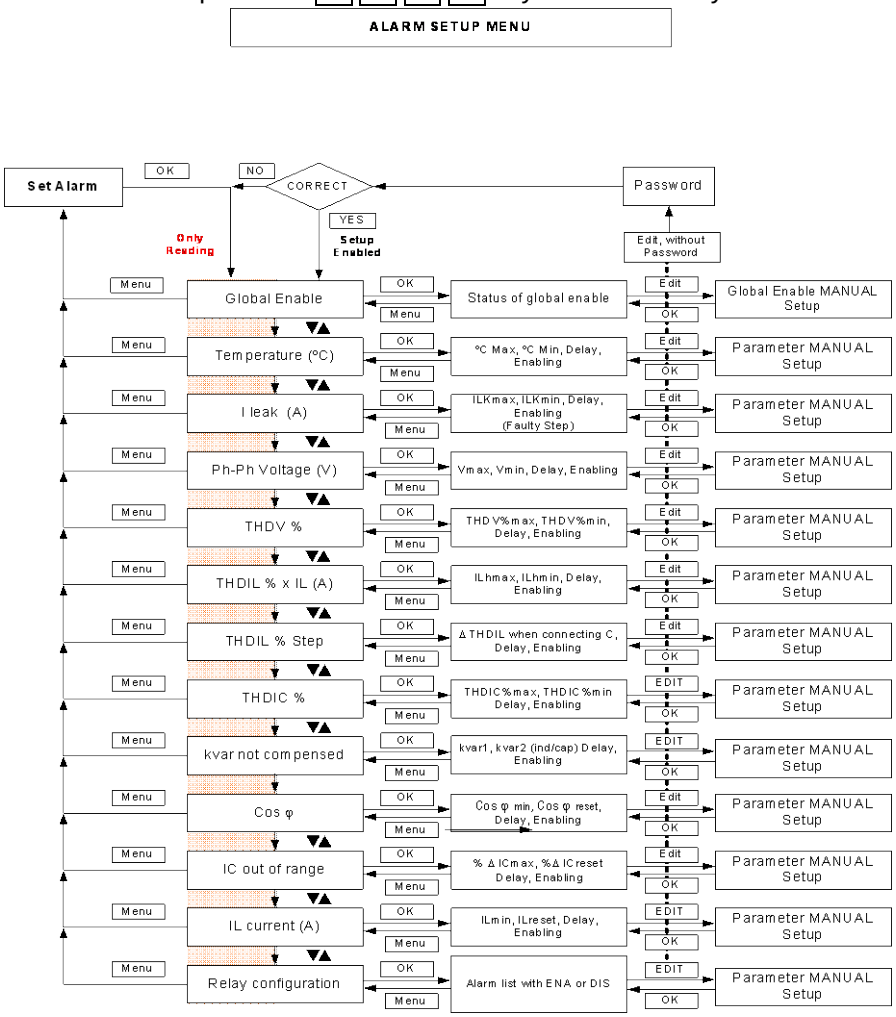


NOTE: Communications are only available for the T8-CDI and T14 CDI versions of **Computer plus**.

Fig.8.- Device setup menu tree

6.3 Alarm setup menu

The alarm setup menu displays and allows the programming of the alarms of the **Computer Plus**. This menu is protected by a password. You can browse the menus and see how the alarms are configured, but you must choose the **Edit** option to edit them. A password will be asked before a modification is permitted. The standard password is the sequence of **F1** **F3** **F2** **F4** keys. The menu layout is shown on Fig.9

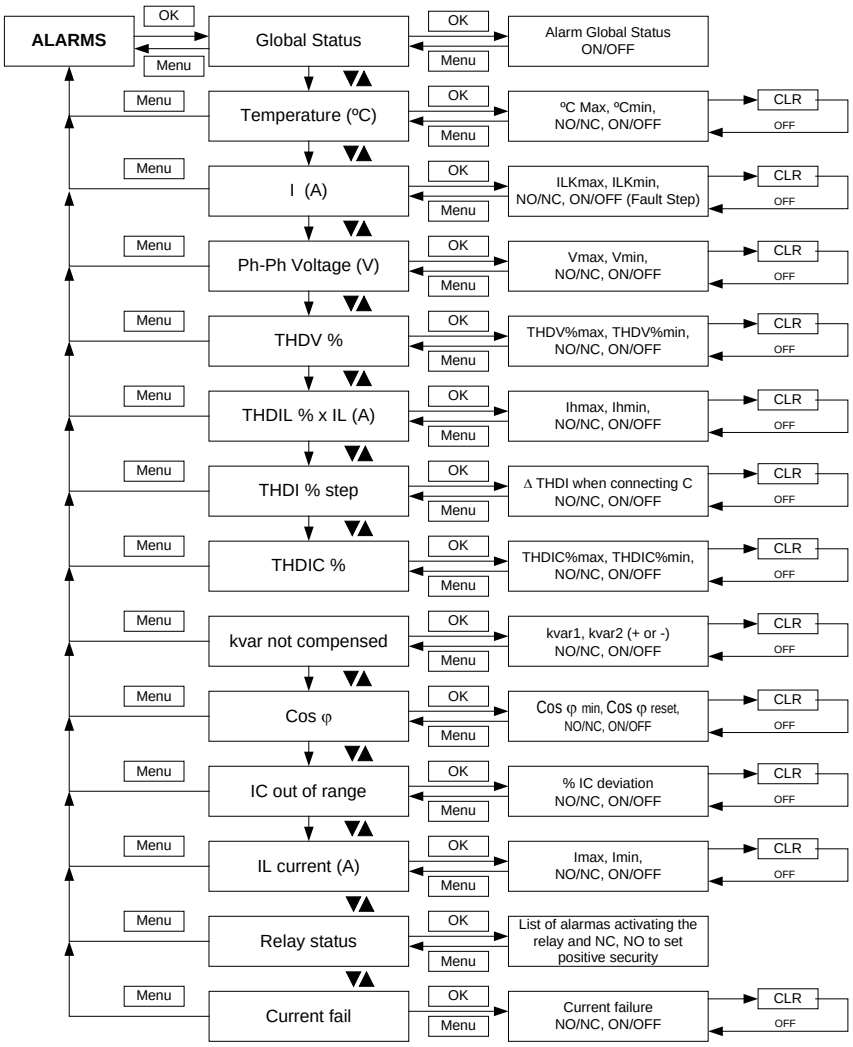


NOTE: The I leak, THDIC and Ic parameters are only available for the T8-CDI and T14 CDI versions of Computer plus

Fig.9.- Alarm setup menu tree

6.4 Alarm status menu

This menu displays and allows resetting of alarms that have tripped, but it can not be used to change the limits or activation status. The menu layout is shown on Fig.10

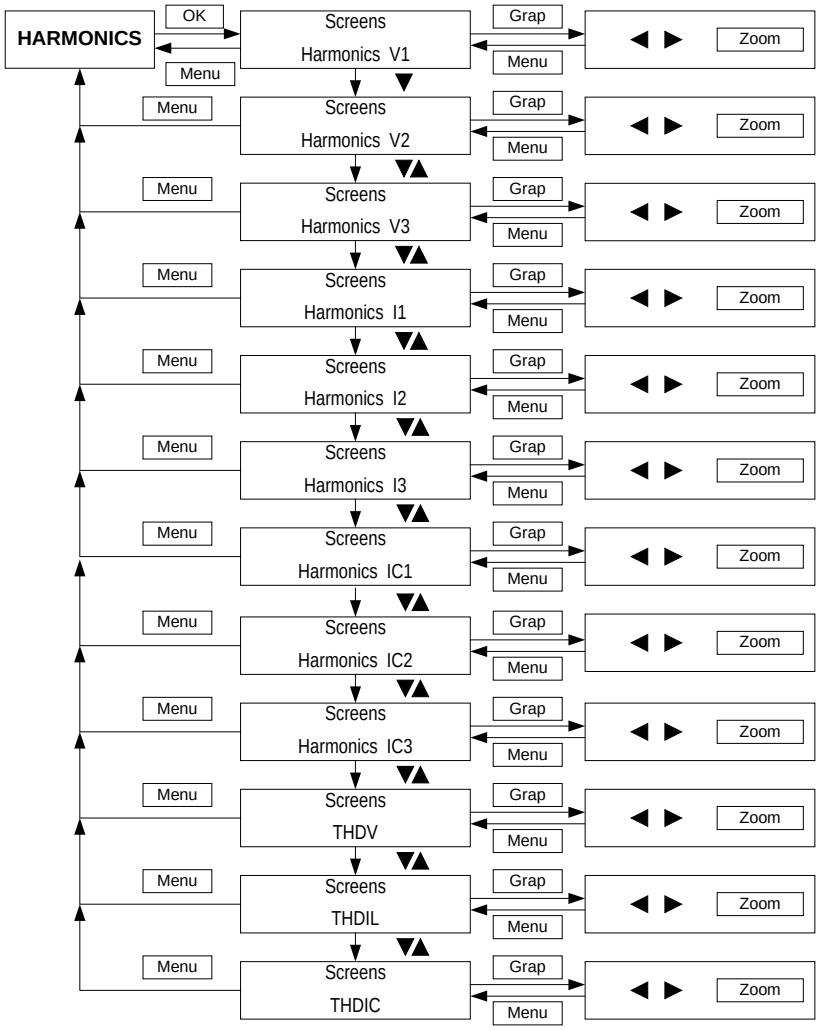


NOTE: The I leak, THDIC and Ic parameters are only available for the T8-CDI and T14 CDI versions of Computer plus

Fig.10.- Alarms menu tree

6.5 Harmonics menu

This menu displays 32 harmonics from the different voltages and currents measured by **Computer plus**.



NOTE: The IC1, IC2, IC3 and THDIC parameters are only available for the T8-CDI and T14 CDI versions of **Computer plus**

Fig.11.- Harmonics menu

6.6 Test menu

The Test menu can be used to enter the device's manual mode. The options in this menu have been designed to carry out different tests of the compensation system, including harmonics prediction tests. When you enter this menu the unit runs manually and, therefore, stops carrying out its regulation functions.

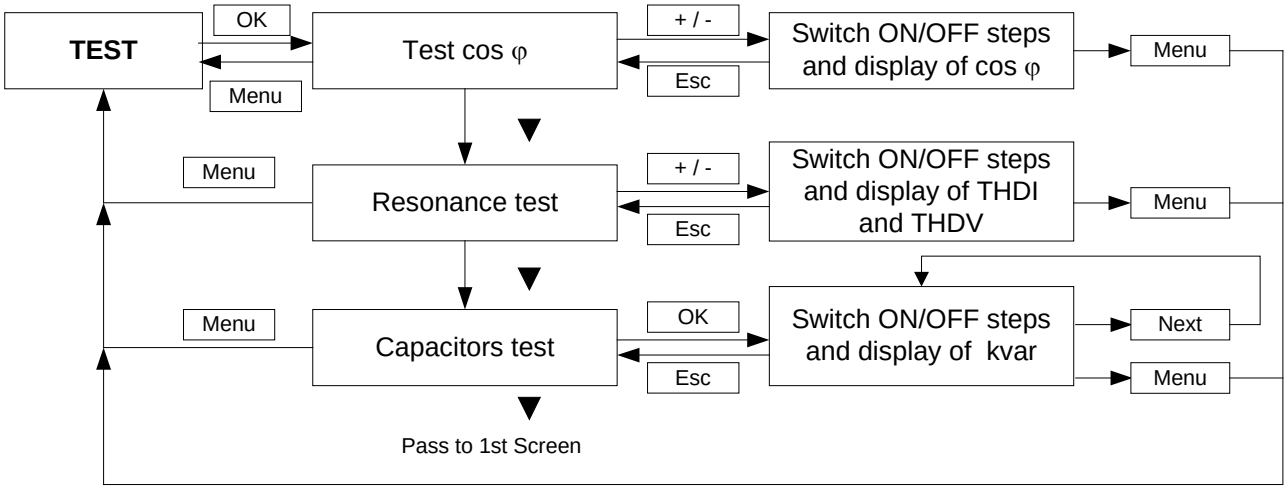


Fig.12.- Test menu tree

7 DEVICE SETUP: SETUP MENU

Computer plus must be programmed to adapt itself to the installation being compensated. Such adaptation process requires the selection of a series of parameters, such as number of capacitor steps, power of each step, current transformer (CT) ratio, etc. All of these parameters can be adjusted as follows:

- Automatic adjustment with the **Plug & Play** option
- **Manual** Adjustment

Please check the **menu tree of the setting described in section 6.2.** before entering the setting

7.1 Password

- The screen shown on Fig. 13 will always be displayed when you wish to change the setup and it will ask for the password. Enter the **F1** **F3** **F2** **F4** key sequence to activate the programming option. The unit will disconnect any connected capacitor steps and then display the setup screen. The right lock-shaped icon indicates whether the unit is locked or not for the edition of adjustable parameters.

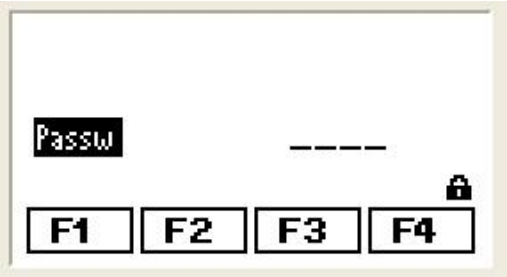


Fig.13.- Password request

7.2 "Plug & Play" Setting

One of the most important features of **Computer plus** when compared to other cheaper regulators is its configuration advantages. **Computer plus** has a **Plug & Play** option in the setup menu. The following data must be entered in this option:

- **Power of each capacitor step**
- **Voltage and connection of capacitors (star or delta).**

  ATTENTION:

  1) During the Plug&Play setup, the device will connect a capacitor step to measure the ratio of the current transformers (CT)

  2) The kvar data of each capacitor step at nominal voltage is labeled on each capacitor.

With this information, the device can configure all other parameters by simply pressing a key, thus saving time and preventing any errors. After calculating the installation's setup and before starting the automatic regulation mode, the device will display a report of the setup of the different parameters and request for confirmation.

The steps that must be followed to configure the device in the **Plug & Play** mode are as follows:

7.2.1 Plug&Play Step 1

- Go to the main menu (Fig. 14)
- Use the arrows to ◄ ► select the folder Setup and press **OK** . Fig.15 will be displayed on the screen.

Fig. 14.- Main menu

Fig.15.- Setup menu

- Select the option C Power kvar and press **OK** . The screen shown on Fig.16 will be displayed.
- Press **Edit** and the password screen will be displayed if the edition is locked. Follow the steps described in section 7.1. After entering the password the screen shown on Fig.17 will be displayed

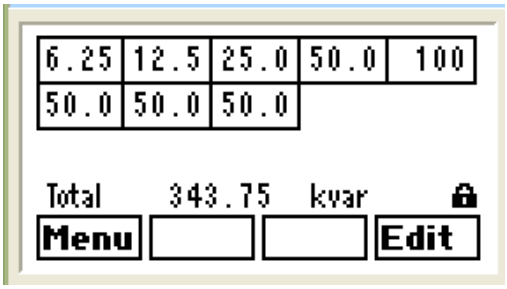


Fig.16.- Programming capacitor power

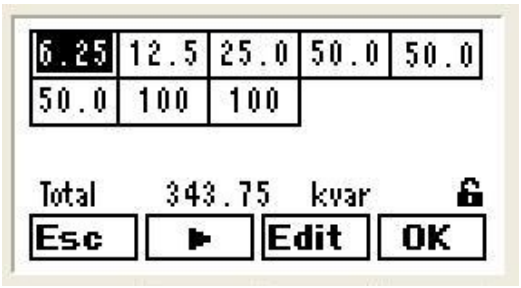


Fig.17.- Programming capacitor power

- On the screen shown on Fig.17, each box represents a capacitor step and the number inside it states the nominal kvar of the capacitor. Use the arrow ► to change the step being adjusted. To adjust the first one, press **Edit** when it is highlighted and the screen shown on Fig. 18 will be displayed, where you can change the kvar of the highlighted step.

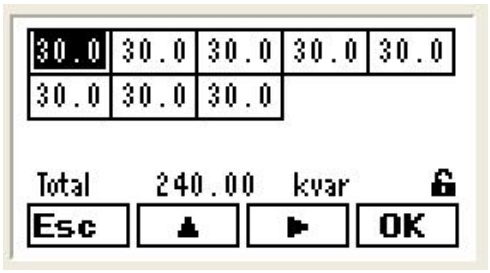


Fig.18.- Programming capacitor power

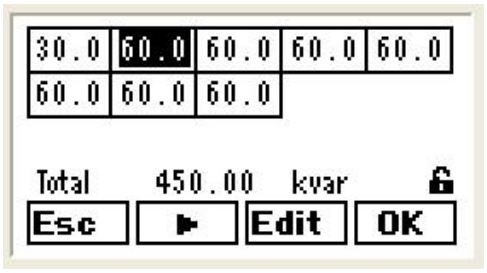


Fig.19.- Programming capacitor power of the second step

- On the screen shown on Fig.18, use the arrow ▶ to change the digit and use the arrow ▲ to change the value. The kvar value will be programmed for each step and it will be confirmed by pressing **OK** .

  NOTE: After programming the first step, all other steps will change their values, using the value of the first one (30 kvar in the case shown on Fig.18). The screen on Fig.17 will be displayed and we can then program the next step. Assume that second step is 60 kvar. Select the second step with ▶ and repeat the operation to program value 60. When this operation is complete, press **OK** and return to the screen shown on Fig. 19, where the next steps have also adopted value 60.

- **Number of steps:** The previous screens show 8 boxes when using **Computer plus T8** and 14 when using **Computer plus T14**. When the unit has fewer steps, for example, 6 steps in a **Computer plus T8**, program step N+1 as zero (in the example on Fig. 20, step 7) and the regulator will then know the number of steps used (in our example, 6 steps). Fig. 21 shows an example of **Computer plus T14** programmed with 10 steps (step 11 and the remaining steps are zero)

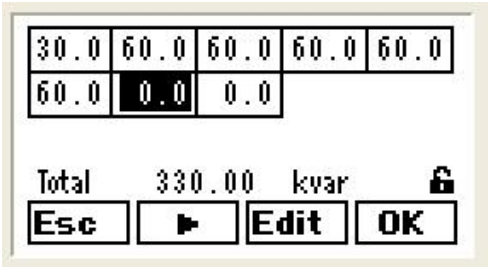


Fig.20.- Programming a 6-step bank (step 7 = 0 kvar) in **Computer plus T8**

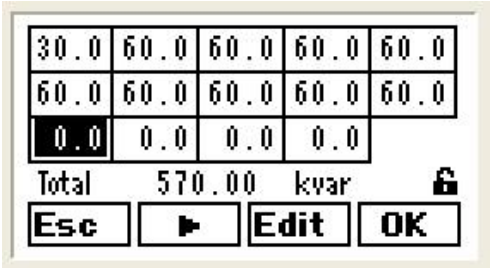


Fig.21.- Programming a 10-step bank (step 11 = 0 kvar) in **Computer plus T14**

7.2.2 Plug&Play Step 2

- **Nominal voltage of capacitors and steps configuration:** The second Plug&Play step involves the selection of the nominal voltage of capacitors and a star or delta connection. This information is usually shown on the label of the capacitors with the nominal power rating. In general, the connection is delta, unless otherwise stated. To enter this information in the regulator, open folder Setup , press **OK** and the screen shown on Fig.22 will be displayed. Select the **V Cap** option and press **Ok**. The screen shown on Fig. 23 will be displayed. Press **Edit** and the screen shown on Fig.24 will be displayed. Select the field edited with ▲▼ and press **Edit** again to display the screen shown on Fig.25. Edit the numbers with arrow ► to change the digit and use the arrow ▲ to change the value. Confirm with **Ok** . Use the **Unit** section to select **V** or **kV** and **Connec** to select △ or **Y**

Fig.22.- Programming the capacitor setup

Fig.23.- Programming the capacitor setup

Fig.24.- Programming the capacitor setup

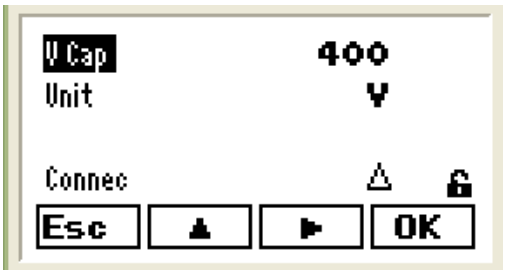


Fig.25.- Programming the capacitor setup

7.2.3 Plug & Play Step 3

- After configuring the power and capacitor steps configuration, the automatic setting can be launched. To do so, select the Plug&Play option from the main menu (Fig.26) and press **OK** . The screen shown on Fig. 27 will be displayed. Confirm the setting by pressing **Do**. Any steps connected will be shown on the screen shown on Fig. 28 or in case of the first setting, the screen of Fig. 29 will be displayed.

Fig.26.- Launch the automatic Plug&Play setting

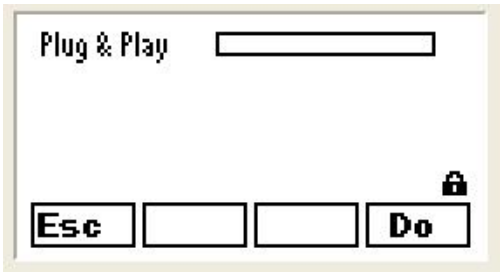


Fig.27.- To start Plug&Play press **Do**

Fig.28.- Plug&Play in case there are steps connected

Fig.29.- Start of Plug&Play

- From this point, the Plug&Play automatic setting will continue allocating the phases and the direction of CT's, allocating each transformer to its phase, while calculating the transformer ratio, always assuming that In/5A transformers are used. The results of automatic adjustments are shown on different screens, as shown on Fig.30 to 33.

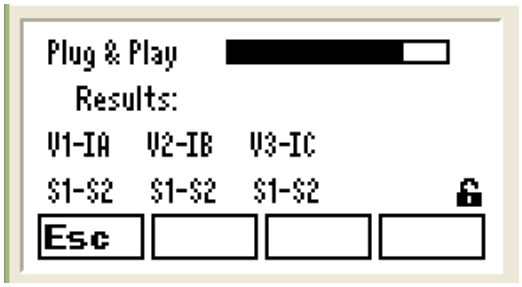


Fig.30.- Plug&Play. Phase allocation information

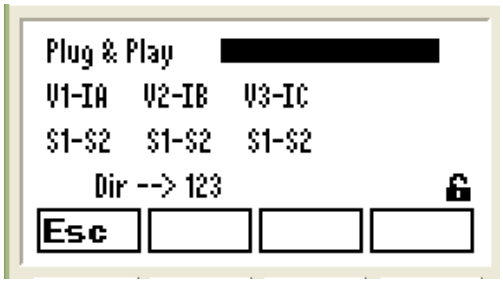


Fig.31.- Plug&Play. Phase allocation information

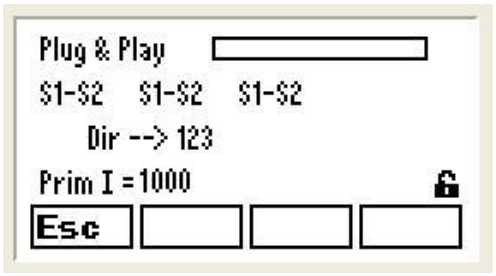


Fig.32.- Plug&Play. Secondary sense, phase sequence and primary current transformers information

Fig.33.- End of Plug&Play

7.2.4 Interpretation of the settings made by Plug & Play

- The screen shown on Fig.30 shows information about the phase to which the current transformers have been connected (CT). If IA, IB and IC are shown together with V1, V2, V3 and all are in the S1-S2 order, each CT is connected to the correct phase and in the correct direction. However, if you have the example shown on Fig. 31, this would mean that the current in phase C has been connected instead of B and vice versa, and phase 3 secondary terminals of the CT have been inverted.

  NOTE: This information is usually correct if the load is inductive or slightly capacitive during the Plug&Play setting (cos phi between 0.65 inductive and 0.98 capacitive). In any case, if you consider that the connections are correct, you can repeat the Plug&Play setting and if the results are the same, there is a high probability that the connections are as detected by the automatic setting unit.

- The screen on Fig. 32 shows information about the phases sequence connected to V1, V2, V3 and about the CT's ratio, both detected by the Plug&Play automatic setting system.

- The final automatic setting is shown on the screen displayed on Fig. 33, indicating the end of the Plug&Play.

- If there is an error message at the end of the automatic adjustment process, carry out the process again and if the error persists, the system must be adjusted manually, as described in section 7.3.
- If there is no error message at the end of the automatic adjustment process, we will press the key **Run** to check whether the values of cos φ and the number of steps to be connected are logical or not (see Fig. 33b). If we consider that these values are correct, then we must press again the key **Run** to start the regulator operation.

7.2.5 Default Plug&Play Values

Some parameters affect the compensation process and they are configured by the Plug & Play by default.

The default values of the parameters are shown on table 7.1.

Parameter	Meaning	Default values
cos φ objective	Desired cos value φ	1
Default connection of capacitors	Steps configuration	Delta
Tact	Connection/Disconnection time between steps	10 s
Trec	Reclosing time of the same step	50 s
V1/V2 voltage transformer ratio	Transformer ratio of voltage measurement transformers (generally 1, except in the case of MV or HV)	1/1
Current transformer secondary	Nominal value of I2	/5
Menu language		Spanish
Parameters of the communications channel	Parameters of the communications channel	Peripheral...1 Baud rate… 19200 Parity... No Leng. Data… 8 bits Bits Stop… 1

Table 7.1.- Parameters configured by default

7.2.6 Plug & Play for Computer plus T8-CDI and T14-CDI

If using a Computer plus T8-CDI or T14 CDI, to which the secondary signal of 3 voltage transformers has been connected in order to measure the current consumed by each phase of the automatic capacitor bank, and said function has been enabled during the configuration of the regulator, a second Plug & Play process will be run in order to determine the value of the primary of the voltage transformers installed to measure the current consumed by the automatic capacitor bank, and the phases and direction of said transformers will be assigned, assuming in each case In/5A transformers. To enable this function, proceed as described below.

– Inside the Setup folder, select the Configuration CDI option (Fig. 33b), and press **OK** . The screen shown in Fig. 33c will be displayed.

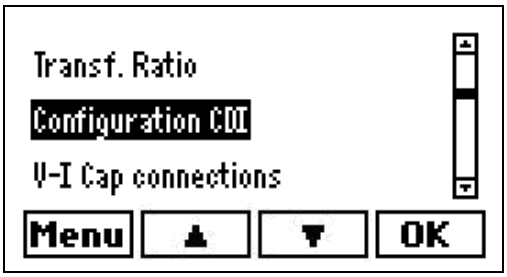


Fig. 33b - Setup menu

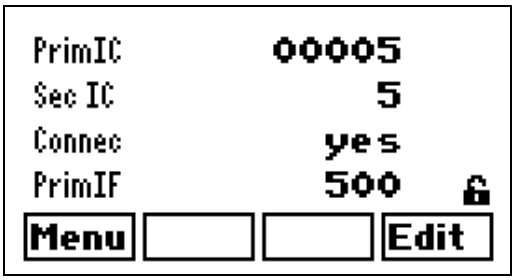


Fig. 33c - CDI setup menu

– Press **Edit** and, if editing is locked, the password screen will be displayed. Follow the steps described in section 7.1. After entering a valid password, the screen shown in Fig. 33d will be displayed.

– Select the Connec option using the ▲▼ button and press **Edit** to set it to yes if it was previously set to no, using the ▲▼ button. Press **OK** to confirm.

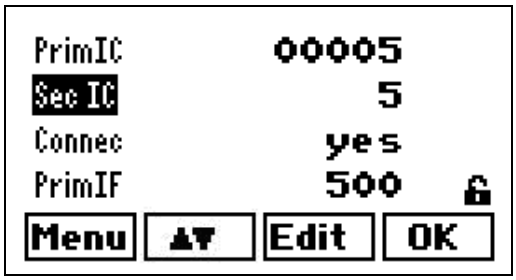


Fig. 33d - CDI setup menu

– In this case, the Plug & Play settings will continue on from the screen shown in Fig. 33, displaying the results of the automatic settings on successive screens, just like for the Plug & Play of the external transformers.

7.3 MANUAL Setup

Even though the easiest way of configuring **Computer plus** is with the **Plug & Play** option, all of the unit's parameters can also be configured manually.

7.3.1 General information about the Setup menu

- To edit a field, follow the procedure described in section 5.4.
- The screen displayed on Fig.33b will be displayed at the end of the adjustment process on any setup screen (final validation of settings with **OK**), showing the cos φ in each phase and three-phase. The unit shows also in reverse video which steps will be connected if the settings are accepted and the unit is put in **Run** mode. The menu bar shows the options to continue editing values when you press **Edit**. The unit will start-up when you press **Run** . At the end of the setup process, when the values displayed on the screen seem logical, both in terms of cos φ values and capacitor steps that will be connected, press **Run** . Otherwise, press **Edit** to return to the setup menu and check for any errors.

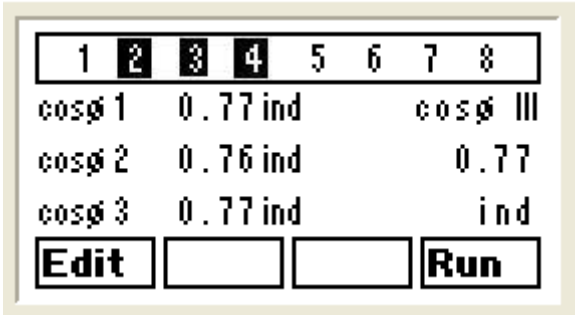


Fig.33b.- Exit any setup screen

7.3.2 Entering the setup menu

- To enter the setup menu, open the main menu (Fig.34). Use the arrows to ◄ ► select the folder Setup and press **OK** . The list of options shown on Fig.35 will be displayed.

Fig. 34.- Main menu

Fig.35.- Setup menu

- You can browse any parameter to see how it is programmed. However, when you attempt to edit a field, a screen will ask for the password (Fig.36). Follow the instructions described in section 7.1 to enter the password.
- If the unit is in operation, the screen shown on Fig. 37 will appear before the setup process is carried out.

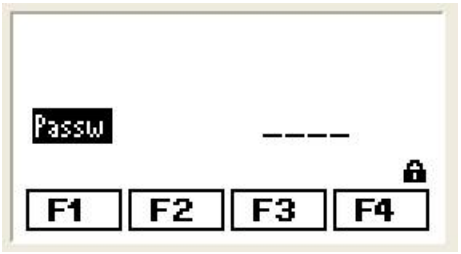


Fig.36.- Password request

Fig. 37.- Setup with connected steps.

- The indispensable parameters that must be configured to start-up the **Computer plus** are:
  - **C Power kvar**
  - **Capacitor**
  - **V-I Connections**
  - **Transf. Ratio**
  - **Compensation**
  - **Target Cos φ**
  - **tact, trec**
- Apart from the minimum parameters shown on the previous list, **Computer plus** has a series of subjective parameters that do not have a direct impact on the compensation process. These parameters are:

- **Date/Time**
- **Display**
- **Communications**
- **Clear/Update**

7.3.3 Adjusting Capacitor Power

This unit can be used to adjust the power of each capacitor step in the compensation unit.

The adjustment method is described in section 7.2.1 for the Plug&Play settings.

NOTE: Any power rating can be used on each step. However, these are usually established in ascending order, respecting the 1:1:1:1; 1:2:2:2 or 1:2:4:4 ratios. In any case, many other different ratios can be used, such as 1:1:2:2:3:3:5:8.

7.3.4 Adjusting and configuring the nominal voltage of capacitors

The second Plug&Play step involves the selection of the nominal voltage of capacitors and a star or delta connection. This information is usually shown on the label of the capacitors with the nominal power rating.

The adjustment method is as described in section 7.2.2 for the Plug&Play settings.

7.3.5 Adjusting the connections of current transformers (CT)

- Open the setup menu by following the process described in section 7.3.2
- Select the **V-I connections** option and press **OK** . The screen on Fig. 39 will be displayed. In this case, the phases connected to the VL1, VL2 and VL3 correspond to the phases where the A, B and C current transformers are connected. Therefore, the default connection is VL1 with IA, VL2 with IB and VL3 with IC. The unit assumes this default connection and measures the **cos φ**. The values are shown on the top part of the screen and the phase sequence on the right (123 or 132). The sequence is measured on the voltage signals. If 132 is displayed, change the VL2 and VL3 voltage cables to correct the situation. When they are in the correct place, the system will show 123.

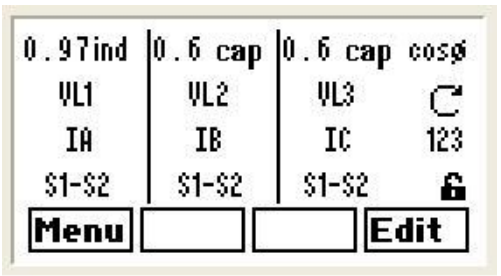


Fig. 38.- Connection of transformers

Fig.39.- Transformer connection menu

- The screen displayed on Fig.39 shows that the VL1, VL2 and VL3 cables might not match the corresponding current transformers. The cos φ values are not coherent with the expected results (an inductive phase and two capacitive phases). Therefore, we must edit the values on the screen, for example, changing IB by IC and inverting S1-S2 until we obtain a set of coherent cos φ values.
- To edit, press the **Edit** option and the screen shown on Fig.38 will be displayed. Use the arrow to change the field being edited. Pressing **Edit** again we may change IB by IC, for example, or S1-S2 by S2-S1.
- If you do not know how the cables of the current transformers (CT's) are connected, try various combinations until you obtain a coherent cos φ reading. Imagine this can be achieved with the setup shown on Fig. 41. This would mean that the CT of phases 2 and 3 are changed and that the secondary of phase 3 has S1-S2 inverted.

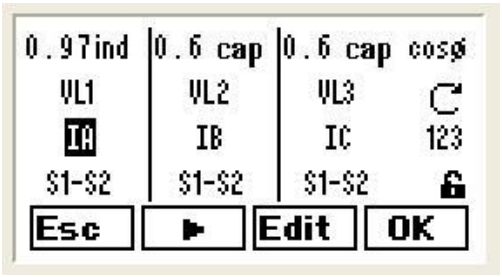


Fig. 40.- Menu to change CT's connection.

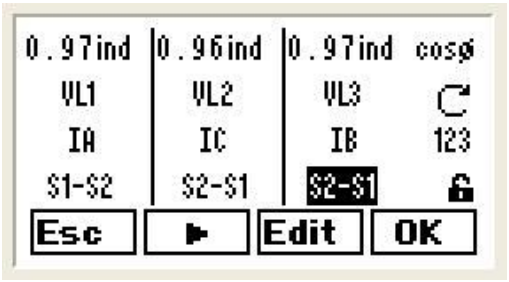


Fig. 41.- Changed transformer connection menu

- When the setup is producing a coherent set of cos φ values, press **OK** and adjust the transformer connections.

7.3.6 Adjusting the transformer ratios

In this menu the voltage transformer and the current transformer ratios can be adjusted. In general, there will only be voltage transformers in the medium or high voltage systems (MV or HV). In the case of low voltage installations, the voltage transformers ratio is 1:1.

To adjust the transformer ratios proceed as follows:

- Open the setup menu by following the process described in section 7.3.2
- From the list of options, select **Transf. Ratio** (screen on Fig.42) and press **OK** to display the screen shown on Fig.43

Fig. 42.- Transformer Ratio Menu

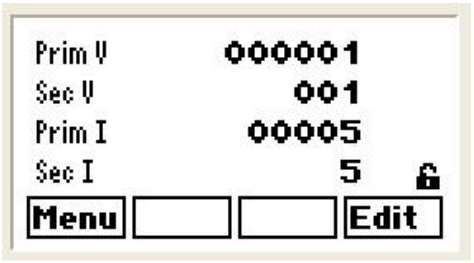


Fig. 43.- Edit Transformer Ratio Menu

- Press **Edit** and the screen shown on Fig.44 will be displayed. To edit a field, follow the procedure described in section 5.4.

Fig. 44.- Transformer Ratio Menu

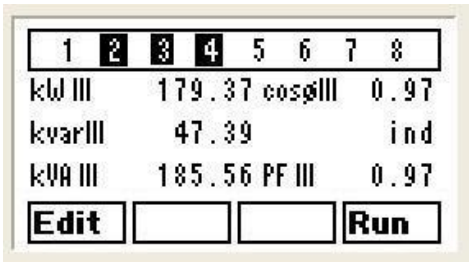


Fig. 45.- Edit Transformer Ratio Menu

- When the adjustment is complete, press **OK** to display the screen shown on Fig.45, stating the kW, kvar, kVA and cos φ. In reverse video, the computer will display the steps which will be connected in case that the settings are accepted. The menu bar shows the options to continue editing values when you press **Edit**. The unit will start-up when you press **Run**. If the values measured seem correct, press Run. Otherwise, check for errors.

7.3.7 Adjusting the cos φ objective

The cos φ objective can be adjusted. To do so, follow this procedure:

- Open the setup menu by following the process described in section 7.3.2
- From the options menu, select **Target cos φ** (screen on Fig.46) and press **OK** . The screen shown on Fig.47 will be displayed

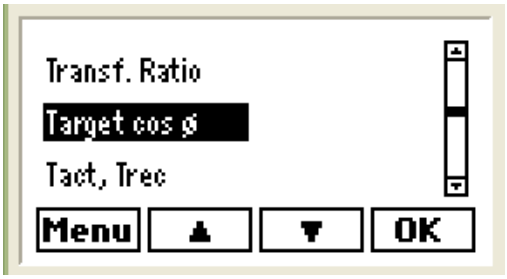


Fig. 46.- Transformer Ratio Menu

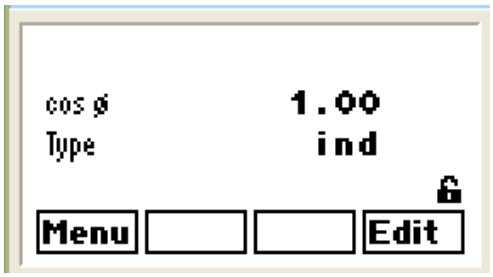


Fig. 47.- Edit Transformer Ratio Menu

- Press **Edit** to adjust the desired value. To edit a field, follow the process described in section 5.4.

7.3.8 Adjusting the Tact and Trec times

The connection, disconnection and reclosing times between steps can be adjusted (reclosing means connection of a previously connected step). To do so, follow this procedure:

- Open the setup menu by following the procedure described in section 7.3.2.
- Select the **Tact, Trec** option and press **OK** The screen on Fig.49 will be displayed.
- Press **Edit** to adjust the desired value. To edit a field, follow the procedure described in section 5.4.

Fig. 48.- Tact, Trec Menu

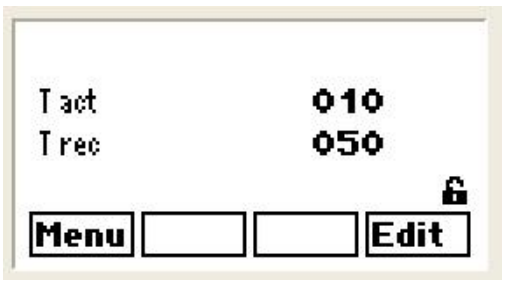


Fig. 49.- Edit Tact, Trec Menu

7.3.9 Adjusting the compensation mode

Various parameters related to the compensation mode can be adjusted. To do so, follow this procedure:

- Open the setup menu by following the process described in section 7.3.2.
- Select the **Compensation** (Fig.50) option and press **OK** . The screen on Fig.51 will be displayed.

– Press **Edit** to adjust the desired parameter values.

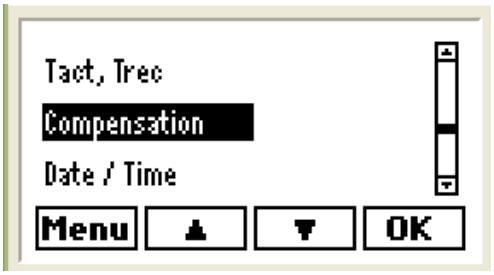


Fig. 50.- Tact, Trec Menu

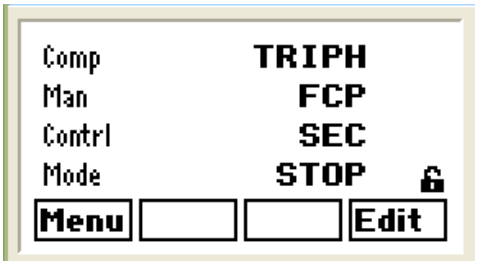


Fig. 51.- Edit Tact, Trec Menu

– The options available are:

TRIPH… In the case of **Computer plus** T8 or T14 with relay outputs, this is the only option available.

FCP or LINEAR… This option is related to steps sequence FIFO (FCP) or LIFO (LINEAR). The FIFO mode means that the first in is the first out (disconnected) and the LINEAR mode means that the last one in is the first one disconnected.

SEC… In the case of **Computer plus** T8 or T14 with relay outputs, there are no options available.

Mode… You can choose between **RUN** or **STOP**, which can be used to start or stop the **Computer plus**.

– To edit a field, follow the process described in section 5.4.

7.3.10 Adjusting the Date and Time

– Open the setup menu by following the process described in section 7.3.2.

– Select the **Date / Time** (Fig.52) option and press **OK** The screen on Fig.53 will be displayed.

– Press **Edit** to adjust the desired **day/month/year** and **hour:minute:second** values.

– To edit a field, follow the procedure described in section 5.4.

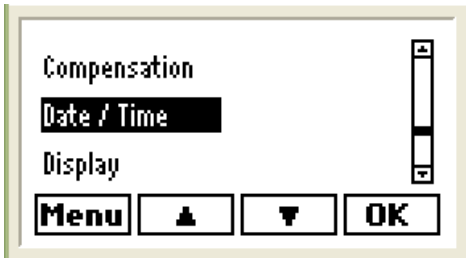


Fig. 52.- **Date and Hour** Adjustment Menu

Fig. 53.- Edit **Date and Hour** Adjustment Menu

7.3.11 Adjusting the Display

- Open the setup menu by following the procedure described in section 7.3.2.
- Select the **Display** (Fig.54) option and press **OK** . The screen on Fig.55 will be displayed.
- Press **Edit** to adjust the desired parameter values.

Fig. 54.- Display Adjustment Menu

Fig. 55.- Edit Display Adjustment Menu

- The following parameters can be configured:

  Cont … Adjust the screen contrast. Adjustable between 00 and 99

  BLight… This option adjusts the display's back light. The settings are:

  ON… Always on

  OFF… Always off

  10 , 90 or 180… Seconds during which the back light of the display is on after the last key has been pressed

  Lang… Choose **Spanish** or **English**

- To edit a field, follow the procedure described in section 5.4.

7.3.12 Adjusting Communication Settings

This option is used to adjust the communication parameters when the **Computer plus** unit is integrated in a network with “Power Studio Scada”. To adjust the parameters follow these steps:

- Open the setup menu by following the process described in section 7.3.2.
- Select the **Communications** (Fig.56) option and press **OK** . The screen on Fig.57 will be displayed.
- Press **Edit** to adjust the desired parameter values.

Fig. 56.- Communications Adjustment Menu

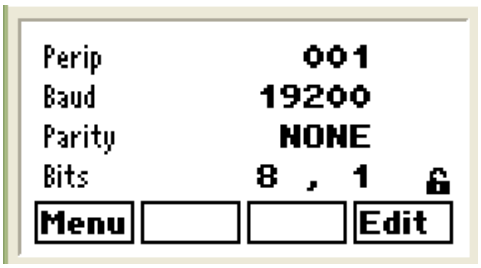


Fig. 57.- Edit Communications Adjustment Menu

- The following parameters can be configured:

  Perip … Adjustment of the peripheral number when **Computer plus** is in a network of instruments connected to “Power Studio Scada”. Adjustable between 001 and 255

  Baud…This option adjusts the communication speed (Baud rate). The options are: 9600, 19200, 38400 and 57600

  Parity… Adjusts the parity. The options are: None, Even, Odd

  Bits… Adjusts the number of bits and Stop bits. The options are: 8bits , 1stop or 8bits , 2stop

- To edit a field, follow the procedure described in section 5.4.

7.3.13 Adjusting Clear/Update

This option can be used to delete the maximum or minimum records and enter the device's reprogramming system.

- Open the setup menu by following the process described in section 7.3.2.
- Select the **Clear / Update** (Fig.58) option and press **OK** . The screen on Fig.59 will be displayed.
- Press **Edit** to adjust the desired parameter values.

Fig. 58.- Clear / Update Menu

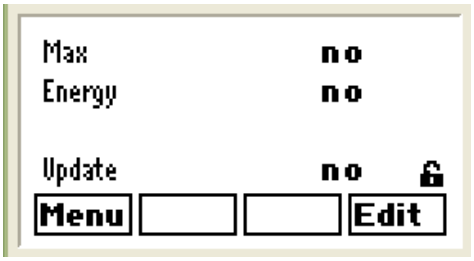


Fig. 59.- Edit Clear / Update Menu

- The following parameters can be configured:

  Max… Deletes the maximum and minimum values recorded

  Energy.… Resets energy meters

  Update… This option updates the unit's software when the adequate software is used. This option is only available for CIRCUTOR's technical service.

7.3.14 CDI module settings

If using a Computer plus T8-CDI and T14 CDI regulator, it is possible to enable the function for measuring the current absorbed by each phase of the automatic capacitor bank, the value of the voltage transformer primary to use to measure said current, and - in the event that an earth leakage transformer is to be installed to control the leakage intensity from the capacitor bank, the number of turns of said earth leakage transformer. To adjust the parameters, follow these steps:

- Open the setup menu by following the procedure described in section 7.3.2.
- Select the Configuration CDI option (Fig. 59b) and press Ok. The screen shown in Fig. 59c will be displayed.

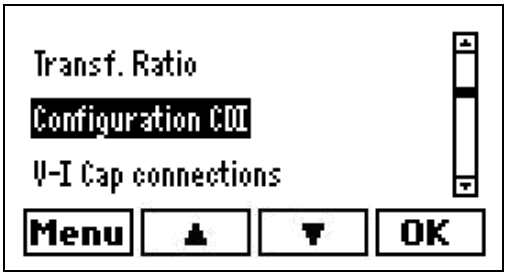


Fig. 59b - Setup menu

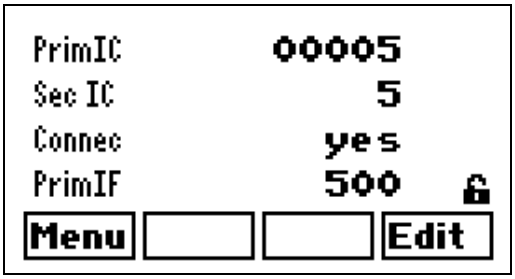


Fig. 59c - CDI setup menu

- Press **Edit** to set the desired parameter values.
- The following parameters can be set:

  PrimIC...Nominal value of the current transformer primary.

  Sec IC... PrimIC...Nominal value of the current transformer secondary.

  Conex… Enabling of the function to measure the current absorbed by each phase of the automatic capacitor bank.

  PrimIF… Sets the number of turns of the earth leakage transformer. If this is of the CIRCUTOR WG type, this value should be **500**. If it is of the CIRCUTOR WN type, it should be **1000**.

- To edit a field, follow the procedure described in section 5.4.

7.3.15 Setting the current transformer connections for the CDI module

- Open the setup menu by following the process described in section 7.3.2
- Select the V-I Cap connections option (Fig. 59d) and press **Ok**. The screen shown in Fig. 59e will be displayed.

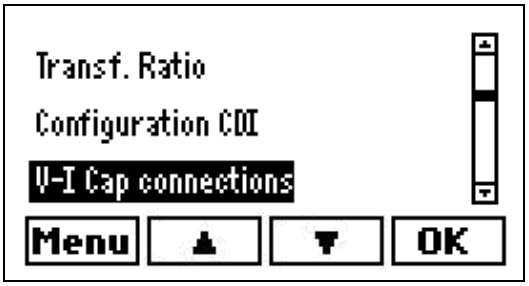


Fig. 59d - CDI transformer connection

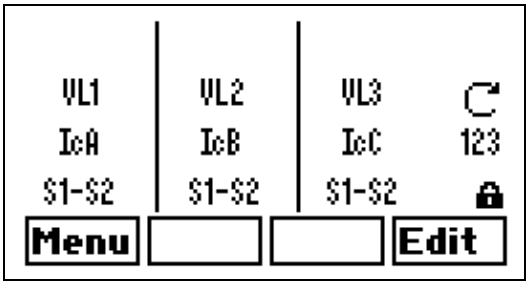


Fig. 59e - CDI transformer connection menu

- On this screen, the phases connected to the VL1, VL2 and VL3 input terminals correspond to the phases where the A, B and C current transformers are connected. Therefore, the default connection is VL1 with IcA, VL2 with IcB and VL3 with IcC.
- The location of the current transformers should be checked visually and, if necessary, this screen should be edited in order to make the necessary changes.
- To edit the screen, press the **Edit** option and a screen like the one shown in Fig. 59f will be displayed. Use the arrow to change the field being edited and press **Edit** again to change IB for IC, for example, or S1-S2 for S2-S1.

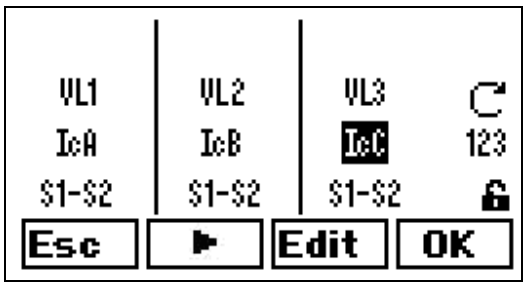


Fig. 59f - CDI transformer connection menu

- Once we have finished making the correct settings, press **Ok** and the connections of the transformers for the CDI modules will be set.

8 DISPLAY OF VARIABLES: MEASURE MENU

Computer plus has a menu with a series of options that can be used to display the measurements of the most important variables of the installation where the power factor is regulated.

See the menu tree in section 6.1 for a general outline of the measurement options available.

8.1 Opening the measure menu

- To open the measure menu, go to the main menu (Fig.60). Use the arrows ◄ ► to select the folder Measure and press **OK**. The list of options will be displayed, as shown on Fig.61

Fig. 60.- Main menu

Fig.61.- Setup menu

8.2 Measurable parameters

- The options available and measurable parameters are summarized on table 8.1.
- Each option can be selected with two different ways:

A) Search the specific parameter and press **OK**

B) Moving onto the next or previous screen with the browsing arrows.

Options	Display	Parameters displayed on the screen
Power, cos φ, FPIII	Fig. 62	Displays the three-phase active, reactive and apparent power and the cos φ and three-phase PF
Status III	Fig. 63	Shows the number of steps connected, kvarC III connected and the frequency of supply
Status	Fig. 64	Shows the kvarC connected to each phase
cos φ	Fig. 65	Shows the cos φ of each phase and the cos φ III
PF	Fig. 66	Shows the PF of each phase and PF III
V phase-phase	Fig. 67	Shows the phase - phase voltages of the installation
V phase-neutral	Fig. 68	Shows the phase - neutral voltages of the installation
I line	Fig. 69	Shows the line current of each phase
I neutral	Fig. 70	Shows the installation's neutral current (parameter calculated, not measured)
I Cond	Fig. 71	Shows the current of each phase of the capacitor bank
I leak, I N Cond	Fig. 72	(*) Shows the leakage current (measured) of the capacitor bank.
Power III	Fig. 73	Shows the three-phase active, reactive and apparent power
kW	Fig. 74	Shows the active power of each phase
kvar	Fig. 75	Shows the reactive power of each phase
kVA	Fig. 76	Shows the apparent power of each phase
Temperature	Fig. 77	Shows the temperature inside the Computer. This temperature is usually 10ºC above the temperature in the cabinet's environment.
Imported Energy III	Fig. 78	Shows the energies in kWh, kvarL and kvarCh, imported since the last meter reset.
Exported Energy III	Fig. 79	Shows the energies in kWh, kvarL and kvarCh, exported since the last meter reset.

(*) Only in Computer plus T8-CDI and T14-CDI

Table 8.1.- Options of the measurement menu and data measured

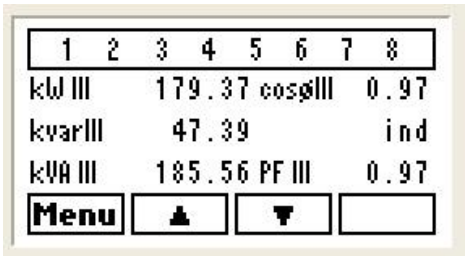


Fig. 62.-Power, cos φ, FPIII

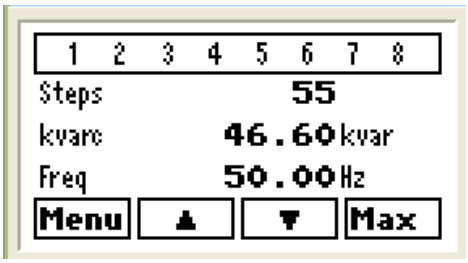


Fig.63.- Status III

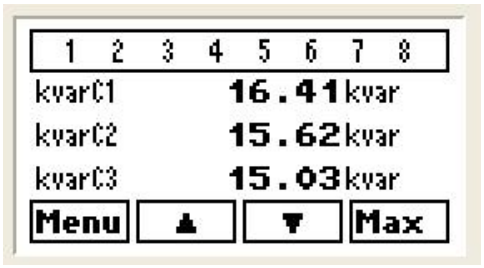


Fig. 64.- Status

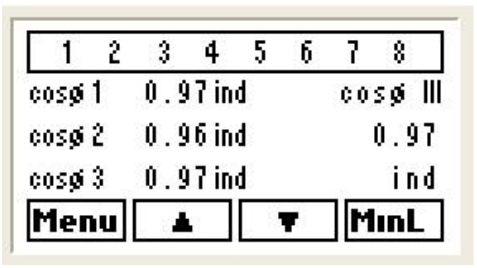


Fig.65.- cos φ

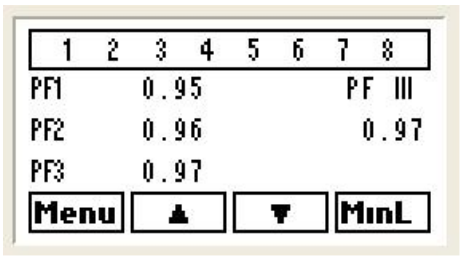


Fig. 66.- PF

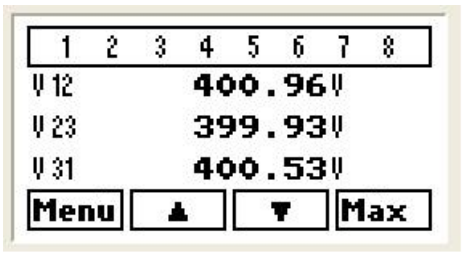


Fig.67.- V phase-phase

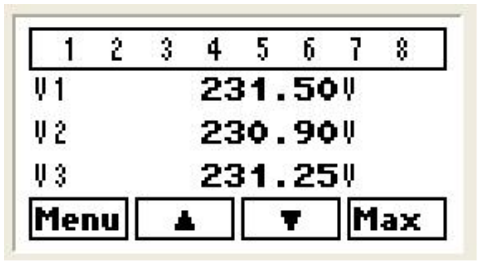


Fig. 68.- V phase-neutral

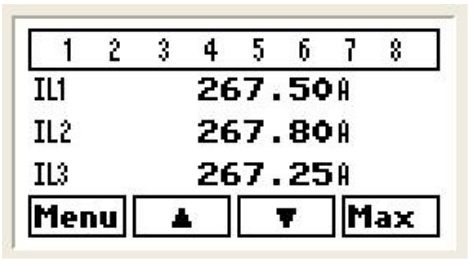


Fig.69.- I Line

Fig. 70.- I Neutral

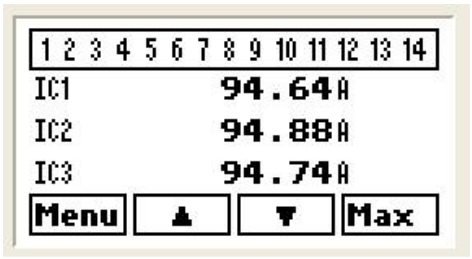


Fig.71.- I Cond

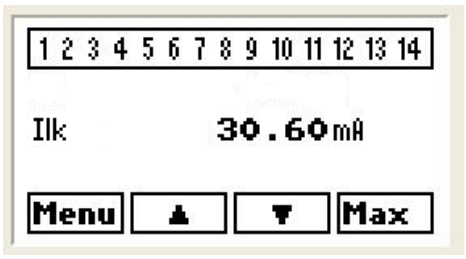


Fig. 72.- I leak Cond

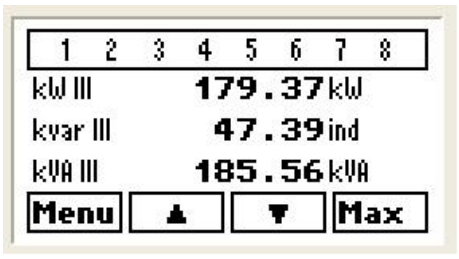


Fig.73.- Power III

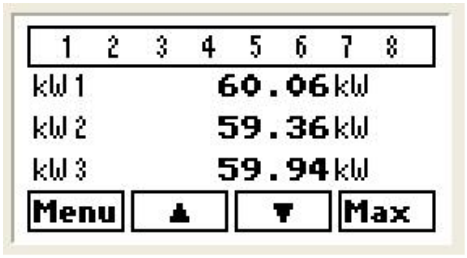


Fig. 74.- kW

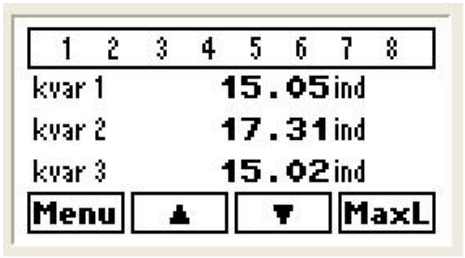


Fig.75.- kvar

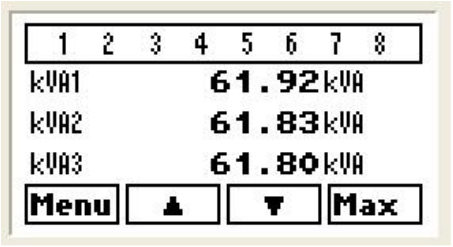


Fig. 76.- kVA

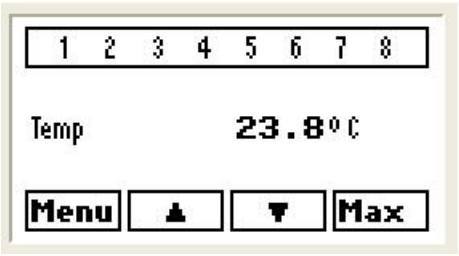


Fig.77.- Temperature

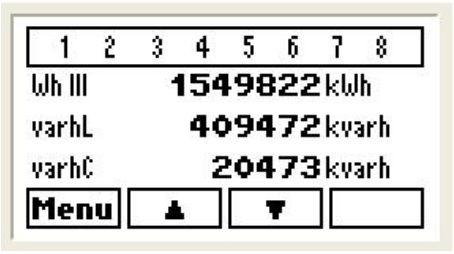


Fig. 78.- Imported Energy III

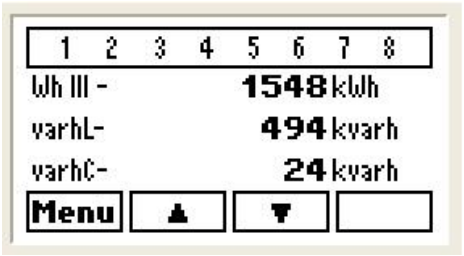


Fig.79.- Exported Energy III

– Some parameters record the maximum or minimum values and indicate the date and hour when they occur. The parameter screens show the **Max** or **Min** option (see Figs. 62 to 79). A screen will be displayed with the values recorded when you press **Max** or **Min**, with the possibility of displaying the date and time when they occur (see Figs. 80 and 81). To exit these submenus, press **Esc** .

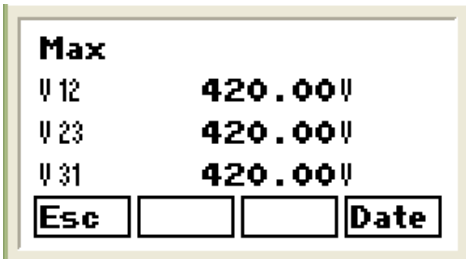


Fig. 80.- Maximum value screen

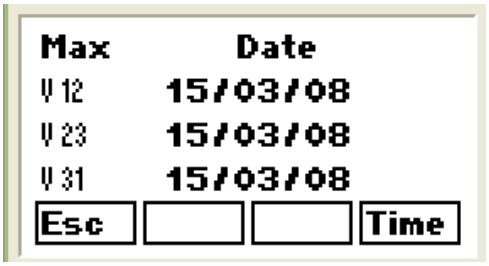


Fig.81.- Maximum value screen: Date and hour

9 ALARM SETUP

Computer plus has a series of alarms that can be configured according to projection needs. See the abridged menu tree in section 6.3 for a general outline of the alarm options available

9.1 Opening the alarm configuration menu

- To open the alarm setup menu, go to the main menu (Fig.82). Use the arrows ◄ ► to select the folder Set Alarm and press **OK**. The list of options will be displayed, as shown on Fig.83

Fig. 82.- Main menu

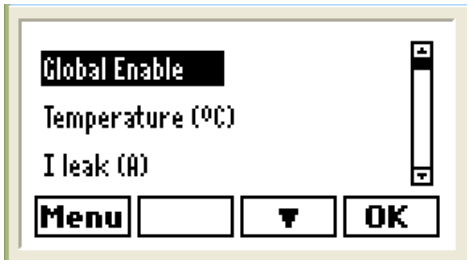


Fig.83.- Set alarm menu

- You can browse each alarm to see how they are programmed. However, when you wish to edit a field, a screen will ask for the password (Fig.13). Follow the instructions described in section 7.1 to enter the password.

9.2 Alarm setup options

- Table 9.1 shows a summary of each alarm option that can be configured and table 9.2 defines each option available.

Options	Programmable alarm parameters
Global Enable	Global activation of all alarms
Temperature (ºC)	Alarm limits by temperature (HI-LO), delay time (DelayT) and type of activity (NO, NC, DIS)
I leak (A) (1) (2) (See 9.4.1)	Alarm limits by I leakage (HI-LO), delay time (DelayT) and type of activity (NO, NC, DIS) The alarm is only available in Computer plus T8-CDI and T14-CDI. The LO value must always be set to zero.
Ph-Ph Voltage (V)	Alarm limits of phase-phase voltage (HI-LO), delay time (DelayT) and type of activity (NO, NC, DIS)
THDV % (2)	Alarm limits by THDV (HI-LO), delay time (DelayT) and trip mode (NO, NC, DIS) The LO value must always be set to zero.
THDIL x IL (A) (2)	Alarm limits of total harmonic current (HI-LO), delay time (DelayT) and type of activity (NO, NC, DIS). The LO value must always be set to zero.
THDIL% Step (2)	Alarm limits of an increase in the THDI (HI-LO) when a C step is connected. In this case, instead of a delay, the number of times the anomaly must be detected before tripping the alarm can be programmed (N Rep). Likewise, the type of activity can be programmed (NO, NC, DIS). The LO value must always be set to zero.
THDIC% (1) (2)	Alarm limits of THDIC (HI-LO), delay time (DelayT) and type of activity (NO, NC, DIS) The alarm is only available in Computer plus T8-CDI and T14-CDI. The LO value must always be set to zero.
kvar not compensed	The LO value indicates the alarm level when there are no steps entered and the HI level indicates the alarm level when steps have been entered. The delay time (DelayT) and trip mode (NO, NC, DIS) can be programmed
Cos φ	The values are ordered from -1 to +1. – are capacitive values and + are inductive values. The delay time (DelayT) and trip mode (NO, NC, DIS) can be programmed
IC out of range (1) (See 9.4.2)	The alarm limits by IC (HI-LO) are programmed in %. In this case, instead of the delay, the number of times that the anomaly must be detected before the alarm is tripped (N Rep) and the trip mode (NO, NC, DIS) can be programmed. The alarm is only available in Computer plus T8-CDI and T14-CDI.
IL current (A)	Alarm limits by IL (HI-LO), delay and trip mode (NO, NC, DIS)
Relay configuration	It can be used to assign the alarms that switch the relay. The relay switches when any of the alarms assigned is activated and when these are enabled and the global enabling is also activated ("OR" function of all alarms assigned to a relay)
Current Failure (See 9.4.3)	Not programmable. Not displayed on the menus. It detects current in any of the three phases below 1% of the nominal value (CT primary). When there is a failure in all three phases, Computer plus disconnects all capacitors and stops the regulation function.
Notes	
(1) These parameters are only available in Computer plus T8-CDI and T14-CDI. (2) In these parameters it does not make sense to have a minimum alarm, so that LO must always be set to zero. (3) All alarms excepts for I leak has a minimum delay time of 1 s and those related to HD(I) and THD(V) of 2 s.	

Table 9.1.- Options of the alarm setup menu and description

Common alarm legends
HI……... High alarm limit value
LO……Low alarm limit value
DelayT… Delay time before the activation of the alarm
NO…… Normally open. The alarm is activated out of the HI, LO limits, i.e., above HI and below LO
NC…… Normally closed. The alarm is activated within the HI, LO interval, i.e., above LO and below HI
NO+Desc… As in the case of NO, but in this case the capacitors are disconnected when there is an alarm.
NC+Desc… As in the case of NC, but in this case the capacitors are disconnected when there is an alarm.
DIS…… Alarm disabled.

Table 9.2.- Definition of legends in the alarm menu

9.3 Configuring each alarm

Select one of the options displayed on the alarm list (Fig.84). The selected option will be displayed in reverse video.

- Once the option is selected, press **OK**.
- Figs. 85 to 87 show the standard alarm edition and setup screens. The fields can be edited in accordance with the procedure described in section 5.4. Press **Edit** to open the screen and edit the HI, LO, DelayT and Enable fields.
- In general, the ▲▼ key is used to browse the options, the **Edit** key to edit the selected field and **Ok** to confirm the selection.
- The different menu options are stated on table 9.2.

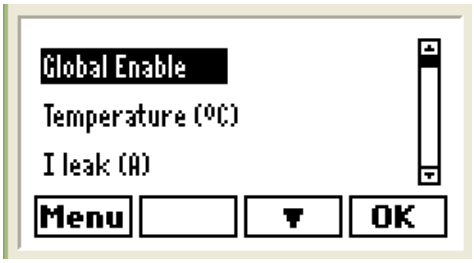


Fig.84.- General alarm menu

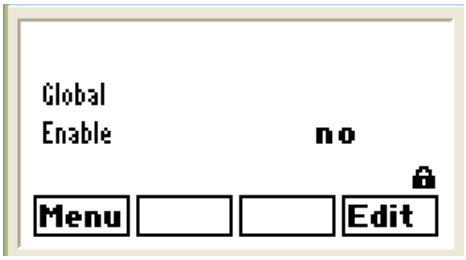


Fig.85.- Global setup

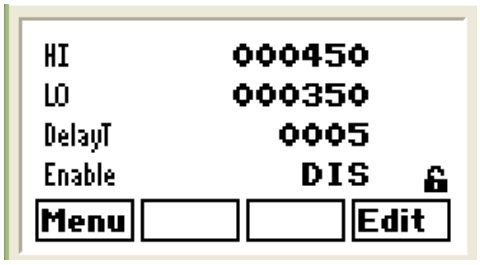


Fig.86.- Configuring standard alarm screens

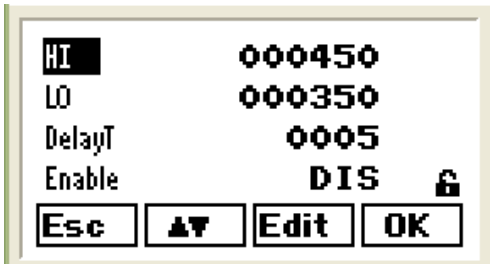


Fig.87.- Editing standard alarm screens

9.4 Special Alarms scenarios

Some alarms have certain peculiarities. In particular, this section describes the three alarms that have a special behavior.

9.4.1 I leak Alarm (A)

This alarm can be used to disconnect a faulty capacitor when it is found to be the cause of a leak. When the **Computer plus (with CDI module and external earth leakage transformer installed)** detects a leak, it triggers the alarm, completely disconnects the capacitor bank and starts a procedure to detect which capacitor/s are causing the leak. During this procedure, the regulator screen will display the message ***PROC ALARM I LEAK*** in the upper portion, and the capacitors will be connected and disconnected in sequence in order to find out which of them are causing the leak, or whether the leak has been provoked by something other than the capacitors.

Upon finishing the search procedure, the device will deactivate the use of those capacitors that have been found to be the cause of the leak, and normal operation will resume with those capacitors remaining inactive. The alarm will be reset and the message ***ALARM*** will be displayed in the upper portion of the screen, alternating with the normal indication of connected steps, and the display light will blink continuously. If the user wishes to reactivate the capacitors, he or she will have to go to the relevant alarm viewing screen (see section 10.2.2), reset the alarm and once again define the power value of said capacitors, C Power kvar, where these capacitors will appear with the value **0.0**.

If the device does not find any capacitor causing the leak, but a leak is still detected, **it will go into STOP mode, with the capacitor bank disconnected**, and the alarm will be triggered, indicating on the screen the message ***ALARM*** in the upper portion, alternating with the text ***MODE STOP***, and the display light will blink continuously. On the Ileak screen, a literal field will specify that there is a leak but that it has not come from any capacitor, **"Err. Ileak**". To return the capacitor bank to normal operation, first the cause of the leak must be eliminated, and then this alarm must be reset (see section 10.2.2).

9.4.2 IC Alarm out of range

This alarm can be used to detect the faulty capacitor when the reactive current exceeds the top or the lower limits by far, in accordance with its nominal power programmed in the Setup Menu. In particular, the HI and LO values are programmed in this case in % and HI should exceed 100%, while LO must be lower than 100% (for example, HI should be programmed at 120% and LO at 80% for a 20% deviation).

9.4.3 Current Failure Alarm

This alarm can not be programmed. **Computer plus** is configured by default so that when a current under 50 mA (1% of the nominal current, in the case of an Ip/5 current transformer) is detected in any of the phases, the alarm will trip. If the currents in the three phases are below 1%, **Computer plus** will disconnect all steps and stop the regulation process.

9.4.4 Earth Leakage Transformer Failure Alarm (Only in T-CDI types)

This alarm can not be programmed. **Computer plus** is configured by default so that when the secondary circuit of the WG earth leakage transformer is open, and the **I leak** alarm is enabled, the alarm will trip. This alarm status will be displayed on the screen of Fig. 96b.

9.5 Programming the alarm relay

There is only one alarm relay and it can be used with any "OR" combination of the available alarms.

– To open the relay configuration menu in the Set Alarm list, select the **Relay configuration** option and press **OK** see Fig.88.

– The list of alarms will be displayed (Fig.89) and you can assign the alarms that will make the relay switch (ON) and which will not make it perform the switching action (OFF). The relay is switched when any of the alarms assigned trips, provided that these are enabled and that the global enabling option is also activated.

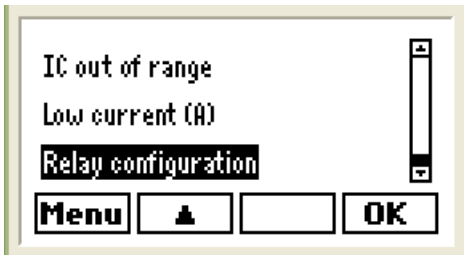


Fig.88.- Configuring standard alarm screens

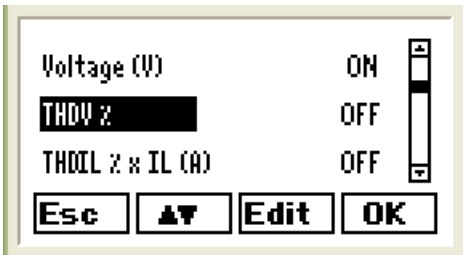


Fig.89.- Editing standard alarm screens

10 VIEWING THE STATE OF THE ALARMS

Computer plus has a menu to display the status of alarms.

ATTENTION:

- **When an alarm has tripped and the global alarm has been activated, the back light of the display will start flashing to warn of this situation.**

- **Alarms can not be configured on the display menu**. To program them, enter the menu Set Alarm See the abridged menu tree in section 6.4 for a general outline of the measurement options available on the display menu.

10.1 Opening the alarm display menu

- To open the alarm display menu, go to the main menu (Fig.90). Use the arrows ◄ ► to select the folder Alarms and press **OK**. The list of options will be displayed, as shown on Fig.91

Fig. 90.- Main menu

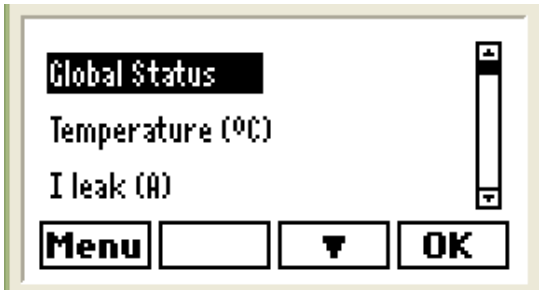


Fig.91.- Alarm display options

10.2 Alarm display options

- The options available and their meaning are summarized on table 10.1.
- Each option can be selected with two different ways:

  A) Searching for the specific alarm and press **OK**

  B) Moving onto the next or previous screen with the browsing arrows. ▲▼

Options	Comments	Meaning
Global Enable		Shows the global alarm enable status. The following can be displayed: ON... Global enable activated and some alarm tripped OFF... Global enable activated and no alarm tripped DIS... Global enable deactivated (All alarms disabled)
Temperature (ºC)		The general operation of the display menu is as follows. When one of the alarms in the list on the screen in Fig. 91 is selected, the Computer shows if the selected alarm is tripped or disabled. ON... Enabled and tripped OFF... Enabled and not tripped DIS... Alarm disabled. If the alarm is ON, press Date , Time to display when the alarm was tripped and press Data to display the maximum and/or minimum value that the variable reached to trip the alarm. Press the CLR dynamic key to reset the alarm, although this can be tripped again if the anomaly is not corrected. To exit the display of a specific alarm, press Esc and press Menu to return to the main menu. *The I leakage and IC out of margin alarms have a special behavior, as described in sections 10.2.2 and 10.2.3*
I leak (A)	The alarm is only available in Computer plus T8-CDI and T14-CDI.	
Ph-Ph Voltage (V)	Voltage phase-phase	
THDV %		
THDIL x IL (A)		
THDIL% step		
THDIC%	The alarm is only available in Computer plus T8-CDI and T14-CDI	
kvar not compensed		
Cos φ		
IC out of range	The alarm is only available in Computer plus T8-CDI and T14-CDI	
IL current (A)		
Relay status	Relay with switched contact	It can be used to view the alarms that switch the relay. The relay is switched when any of the alarms assigned is tripped ("OR" function of all alarms) and the alarm's relay is configured as ON.
Current Failure	This alarm can not be programmed, since it is a default system alarm.	The alarm is tripped when the measured current in one of the phases is under the device's detection threshold *See section 10.2.4*

Table 10.1.- Options of the alarm display menu

10.2.1 Parameters displayed on the alarm status screens.

A screen like the one shown in Fig.92 will be displayed when the status of alarms is browsed. The different screens show the variable, "trip mode" (NO, NC or DIS), HI and LO values programmed and the status ON, OFF, DIS, etc. When the alarm is ON, the date **Date** , time **Time** and value that tripped the alarm can be checked. With the **Data** option, the HI and LO fields show the trip values.

The texts on the screen and their meaning are described on table 10.2.

HI	High value that triggered the alarm. No value will be displayed when the alarm has not been triggered due to HI limit.
LO	Low value that triggered the alarm. No value will be displayed when the alarm has not been triggered due to LO limit.
Status	ON: Alarm enabled and tripped
	OFF: Alarm enabled but tripped
	DIS: Alarm disabled

Table 10-2.- Description of the legends on Fig. 92

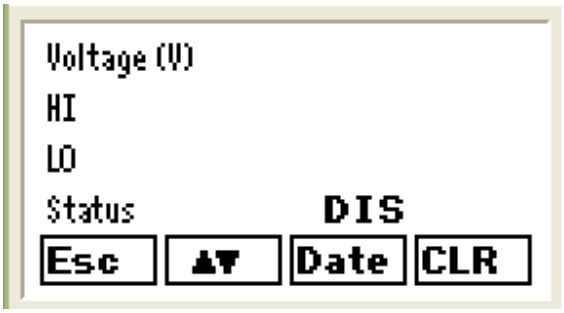


Fig. 92.- Alarm status screen (DIS or OFF)

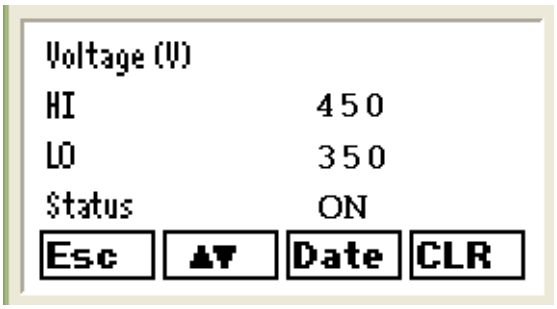


Fig.93.- Alarm status screen (ON)

10.2.2 I leak alarm

As mentioned in section 9.4.1, **Computer plus** will treat this alarm as a special case. Specifically, this alarm can be used to disconnect a faulty capacitor when it is found to be the cause of a leak. As such, if it detects a **leak, it triggers the alarm. Immediately afterwards, it stops the regulation process and starts disconnecting** the connected capacitors one by one until it reaches the cause of the leak (see section 9.4.1 for a complete explanation of the operation of this alarm).

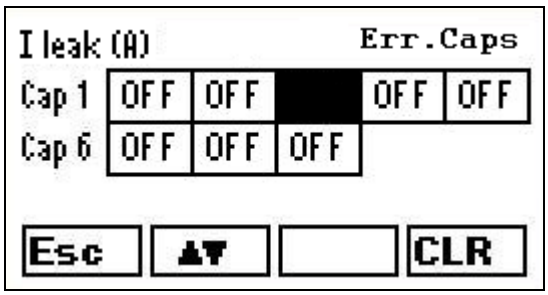


Fig. 94.- I leakage alarm screen

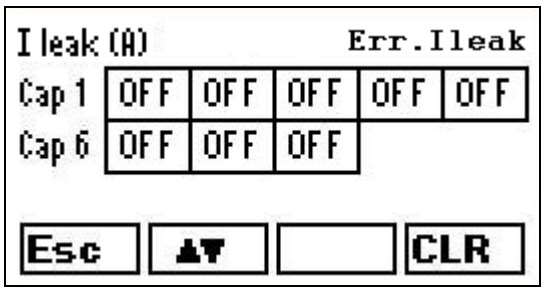


Fig. 95.- I leakage alarm screen

In the case of the I leak alarm, the alarm viewing screen opens a screen which is either like the one shown in Fig. 94 or like the one in Fig. 95.

The screen in Fig. 94 will be displayed when there exists a faulty capacitor which has caused the leak. The box of this capacitor will be shown as entirely blacked out. The **CLR** option can be used to reset the system once the capacitor has been replaced (the alarm will be triggered again if the faulty capacitor has not been replaced).

The screen in Fig. 95 will be displayed when the regulator has not found any capacitor that is the cause of the leak, but a leak is still detected. To return the capacitor bank to normal operation, first the cause of the leak must be eliminated, and then this alarm must be reset using the **CLR** option.

10.2.3 IC out of range Alarm

The IC out of margin alarm is shown when a capacitor is taking an abnormal current. The screen shown on Fig.95 will be displayed when the capacitor current deviates by a certain % of the nominal value and the display will show an ON in the box of the faulty capacitor (Fig. 95). The case on Fig.95 shows that C7 has the alarm triggered (ON).

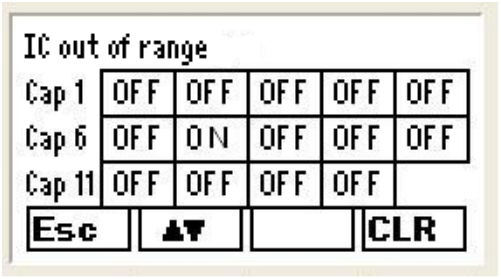


Fig. 96.- *IC out of margin alarm screen*

10.2.4 Current Failure Alarm

The screen shown on Fig. 96b will be displayed when the current in the three phases does not reach 1% of the nominal value.

In T-CDI types this screen also shows the earth leakage transformer failure. So, if this transformer has the secondary circuit open, ON will be shown in **I leak** status.

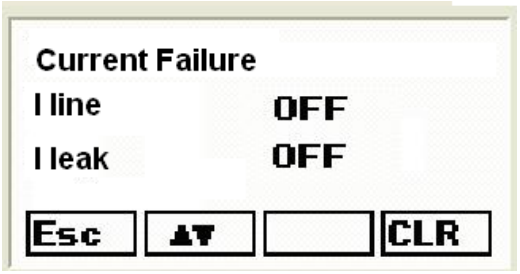


Fig. 96b.- Current fault alarm screen

11 HARMONICS DISPLAY

Computer plus also includes an option to display voltage and current harmonics, or a bar graph for each measured voltage or current.

11.1 Opening the harmonics display menu

- To open the harmonics display menu, go to the main menu (Fig.92). Use the arrows ◄ ► to select the folder Harmonics and press **OK**. The list of options will be displayed, as shown on Fig.93

Fig. 97.- Main menu

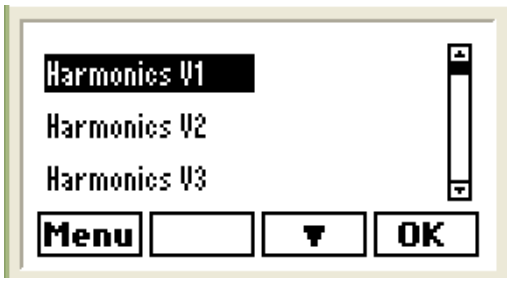


Fig. 98.- Harmonics display options

11.2 Harmonics display options

- The options available and their meaning are summarized on table 11.1.
- The options will be selected from the list shown on Fig. 98 with the dynamic keys [▲] [▼]. Press **OK** when the option selected appears on the reverse video.

Options	Comments	Measurable parameters
Harmonics V1		Shows the voltage harmonics of phase 1
Harmonics V2		Shows the voltage harmonics of phase 2
Harmonics V3		Shows the voltage harmonics of phase 3
Harmonics I1		Shows the current harmonics of phase 1
Harmonics I2		Shows the current harmonics of phase 2
Harmonics I3		Shows the current harmonics of phase 3
Harmonics IC1	Available only in Computer plus T8-CDI and T14-CDI	Shows the current harmonics of phase 1 of the capacitor bank
Harmonics IC2		Shows the current harmonics of phase 2 of the capacitor bank
Harmonics IC3		Shows the current harmonics of phase 3 of the capacitor bank
THDV		Shows the THD voltage of each phase-neutral voltage: V1, V2, V3
THDI		Shows the THD current of each phase-neutral voltage: I1, I2, I3
THDIC	Only available in Computer plus T8-CDI and T14-CDI	Shows the THD current of each current in the compensation unit: IC1, IC2, IC3

Table 11.1.- Options of the harmonics display menu

- Numerical values or bar graphs can be displayed for each variable (see Figs. 99 and 100)

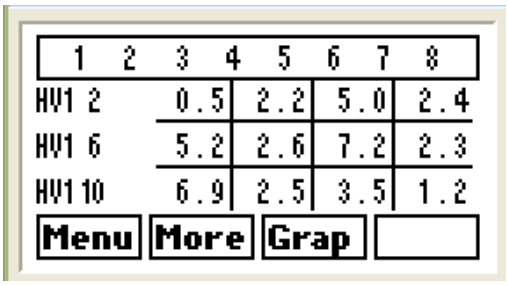


Fig. 99.- Numerical display of harmonics

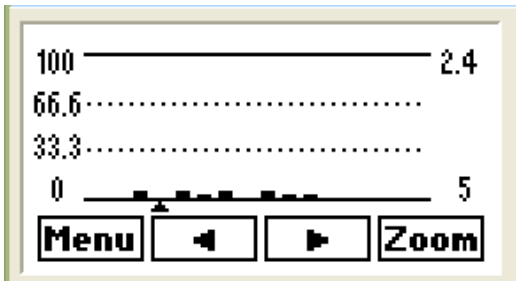


Fig. 100.- Graphical display of harmonics

- Each numerical harmonics display screen shows a table with the value of 12 harmonics (example on Fig.99, row HV1 2 shows the voltage harmonic values of phase 1, in the order of 2 to 5. The next row shows the order from 6 to 9, etc.). Press **More** to see up to the harmonics order 33.

- The numerical display screens show the **Grap** dynamic key. Press the key to display the harmonics in a bar graph (Fig.100) and use the keys ◄ ► to change the harmonics cursor. The harmonics order (lower part) and % value (top part) will be displayed on the right of the screen.
- Use the Zoom key to expand the vertical scale. (Fig.101)

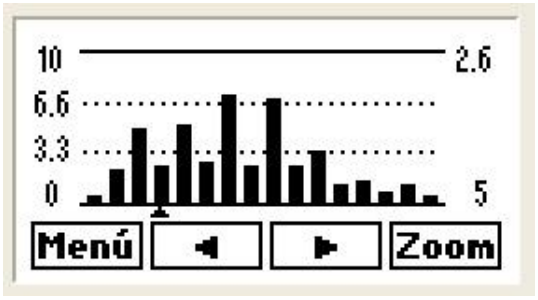


Fig. 101.- Graphical display of harmonics with zoom

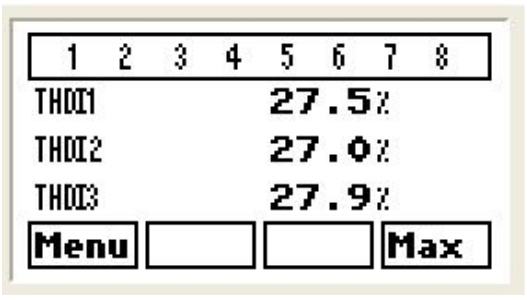


Fig. 102.- Display of THDV or THDI

- The screens that display the current and voltage THD (Fig.102) show the **Max** option, which can be used to display the maximum THD values recorded. The date and time when the maximum value was produced can also be displayed with the **Date** and **Time** dynamic keys
- To go back to any of the harmonics display submenus press **Esc** or **Menu**

12 TEST

Computer plus has a powerful Test menu that allows you to check the power factor compensation unit and check whether it is adapted to the installation being compensated or not. This menu has been designed to check the status of components in the bank after start-up and the potential resonances between the equipment and certain loads in the installation. The Test menu offers three options:

- **Test cos φ**
- **Resonance test**
- **Capacitors test**

12.1 Opening the Test menu

- To open the test menu, go to the main menu (Fig.103). Use the arrows ◄ ► to select the folder Test and press **OK**. A list with the three options available will be displayed (Fig.104)

Fig. 103.- Main menu

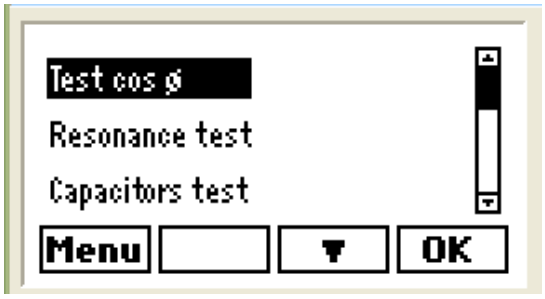


Fig. 104.- Options of the Test menu

– The options can be selected with the ▲ and ▼ dynamic keys; then press **OK**.

12.2 Test cos φ and Resonance test

These two options must be used at the same time. The purpose is to execute the manual connection and disconnection of capacitors while displaying the cos φ or THDV and THDI of each phase. This allows you to check that the compensation unit is working correctly and whether the connection of a certain number of capacitors is causing resonances in the installation or not. Each test is carried out as follows:

– The **Test cos φ** option of **Computer Plus** shows the cos φ of all phases and the type (inductive or capacitive), as well as the cos φ III (total) and its type (Fig.105).

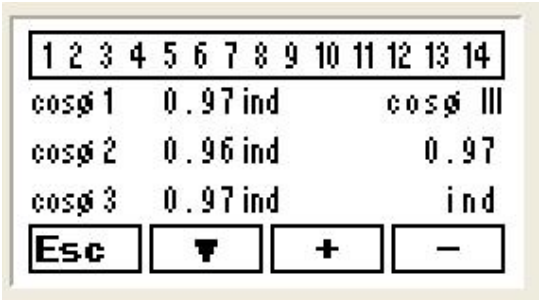


Fig. 105.- Main menu

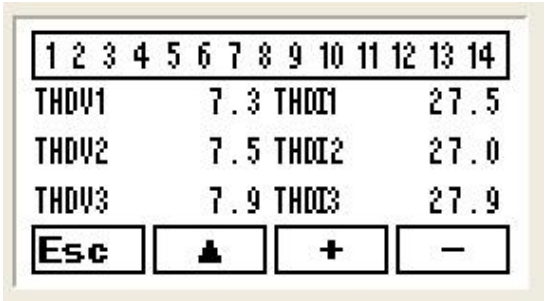


Fig. 106.- Options of the Test menu

– Use the keys + – to connect or disconnect the capacitor steps sequentially. While doing so, check how the cos φ changed when entering or removing steps. This can detect current transformers that are not connected correctly or check whether the compensation is as expected or not.

- The display of **Test cos φ** can be changed to the **Resonance test** screen with the [▼] and [▲] dynamic keys
- The **Resonance test** option allows checking if the connection of a certain number of steps causes resonances in the installation. **Computer plus** shows the values of THDV and THDI for each phase in these menus and the [+] [−] keys can be used to connect and disconnect steps sequentially (Fig. 106).
- If there is a huge increase in the THDI when the installation is overcompensated or for a certain combination of capacitors connected, this might mean that there is resonance in the system. If the unit does not have filters, this would indicate that it would be advisable to install them.

12.3 Capacitors test

- The last option in the Test menu is the **Capacitors test**. This test menu has been designed to test the power of each individual capacitor.
- When you open the **Capacitors test** menu (after pressing [OK] on the option as shown on Fig.107), **Computer plus** will show the screen on Fig. 108. In case there are some capacitors connected, only the [−] button will be active. Keep this button pressed to disconnect the capacitors sequentially. The computer will ask you to introduce the password before starting disconnection (see section 7.1)
- Once all the capacitors are disconnected two more buttons appear (Fig.109)

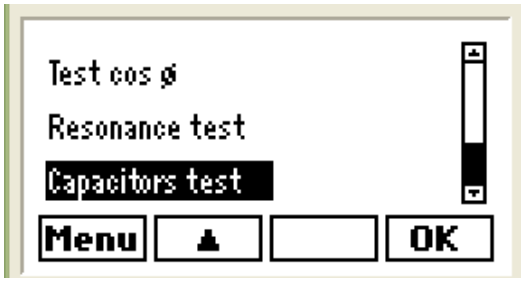


Fig. 107.- Capacitor Test Selection

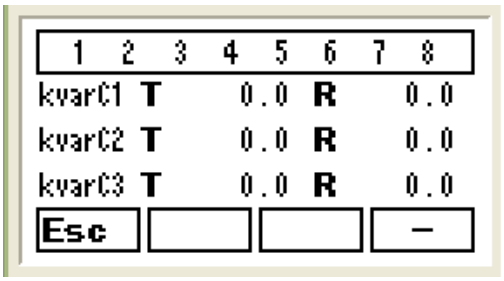


Fig. 108.- Disconnection of capacitors

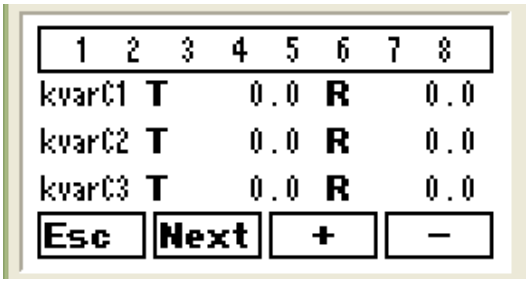


Fig. 109.- Capacitor Test Menu

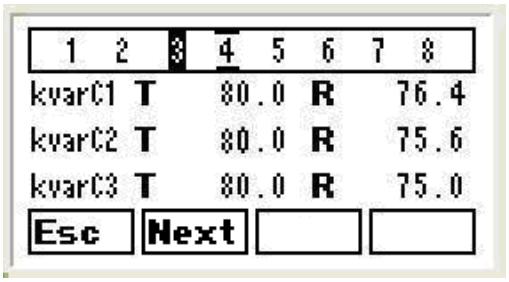


Fig. 110.- Capacitor Test Menu

- Press the button **Next** so that **Computer Plus** will highlight the first capacitor which can be connected, pressing button **+** or disconnect with button **−** (Fig. 110 shows step 3 as connected and step 4 as selected), showing the theoretical kvar (**kvarC1 T**) and real kvar (**kvarC1 R**) on two columns. Each capacitor can be checked individually to see if the expected capacity is met. The connection and disconnection of steps will respect the **tact** and **trec** times.
- To exit this menu, press **Esc** .
- To return to the main menu from the Test menu, press **Menu**.

13 INTEGRATION OF COMPUTER PLUS IN THE SCADA POWER STUDIO PROGRAM

Computer plus T8-CDI or T14-CDI have an RS-485 communications channel, which can be used to integrate them as other peripheral devices in the SCADA “Power Studio” software of CIRCUTOR.

The connection can be made directly with an RS-485 bus or with the integration in an Ethernet network with a converter from RS-485 to Ethernet / Modbus (CIRCUTOR TCP2RS-TCP)

The communication characteristics are defined in the Communications option in the Setup menu. In this sub-menu the peripheral number (identification number of the unit in the Power Studio Scada network unit), the transmission speed and the characteristics of the communication frame to send (parity, stop bits) are selected.

For more details about the SCADA software, see the Power Studio software manual.

14 SAFETY INFORMATION ⚠

The installation standards described in the previous SETTINGS AND START-UP, CONNECTION DIAGRAMS and TECHNICAL CHARACTERISTICS chapters of the unit must be taken into account.

With the unit connected, it is dangerous to touch the terminals. Opening the covers or removing elements may provide access to parts that are also dangerous to the touch. This unit is supplied in good working order.

In case of supply at 110 V a.c., the maximum number of output relays that can be used is 12 in **Computer plus T14** and **Computer plus T14-CDI**.

15 MAINTENANCE

The **Computer plus T** regulator does not require special maintenance. It is necessary to avoid as far as possible all adjustments, maintenance or repairs with the unit open. If they must be carried out, they must be performed by qualified staff who are well informed of the procedure to follow.

Before performing any connection modification, replacement, maintenance or repair operation, disconnect the unit from its power supply. If you suspect an operational fault in the unit or in its protection system, remove the unit from service, ensuring it is not possible to connect it by accident. The design of the unit makes it easy to replace parts in case of a fault.

16 TECHNICAL SERVICE

If you have any doubts about the operation of the unit or any faults, contact our technical service at CIRCUTOR S.A.

CIRCUTOR S.A. - After-sales service

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